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VOLUME 2
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CONTENTS OF VOLUME 2

July, 1918 NEW YORK NUMBER

PAGE

Clinical Lecture by Dr. Frank S. Meara, *Cornell University Medical College*
HYPERPIESIA OF CLIFFORD ALLBUTT (ESSENTIAL HYPERTENSION) 1

Contribution by Dr. William H. Park, *Laboratories of the New York City Department of Health*
PRACTICAL IMMUNIZATION AGAINST DIPHTHERIA 31

Clinic of Dr. Frederick Tilney, *College of Physicians and Surgeons, Neurological Department, Columbia University*
WILSON'S DISEASE—PROGRESSIVE LENTICULAR DEGENERATION 45

Clinic of Dr. Walter L. Niles, *Bellevue Hospital*
SUBACUTE NON-TUBERCULAR PULMONARY INFECTION 67

Contribution by Dr. Charles B. Slade, *Municipal Sanitarium, Otisville, N. Y.*
THE RELATION OF PULMONARY TUBERCULOSIS TO GENERAL PRACTICE 87

Clinic of Dr. E. Libman, *Mount Sinai Hospital*
THE CLINICAL FEATURES OF SUBACUTE STREPTOCOCCUS (AND INFLUENZAL) ENDOCARDITIS IN THE BACTERIAL STAGE 117

Clinic of Dr. Thomas F. Reilly, *Fordham Hospital*
THE MINOR AND MISLEADING EARLY SYMPTOMS OF DISEASE OF THE HEART AND CIRCULATION 153

Clinic of Dr. R. G. Snyder, *City Hospital*
A DISCUSSION OF 3 UNUSUAL CASES OF ANEURYSM OF THORACIC AORTA, WITH AN ILLUSTRATED REPORT OF THE SUBSEQUENT AUTOPSY FINDINGS 165

Clinic of Dr. Walter James Heimann, *Post-Graduate Medical School*
THE RELATION OF INTERNAL DISTURBANCES TO DERMATOLOGIC CONDITIONS 185

Contribution by Dr. Murray H. Bass, *New York*
THE CUTANEOUS MANIFESTATIONS OF ACUTE RHEUMATIC FEVER IN CHILDHOOD 201

Contribution by Dr. Oscar M. Schloss, *Children's Ward, Bellevue Hospital, New York*
ACETONE BODY ACIDOSIS IN CHILDREN 215

Clinic of Dr. Josephine B. Neal, *Willard Parker Hospital*
EPIDEMIC MENINGITIS 223

Clinic of Dr. Burrill B. Crohn, *Mount Sinai Hospital*
CLINICAL CONDITIONS CHARACTERIZED BY OBSTRUCTIVE JAUNDICE 245

Clinic of Dr. S. Philip Goodhart, *Montefiore Hospital*
THE PRIMARY MYOPATHIES AND THEIR ENDOCRINE RELATIONSHIP 259

Clinic of Dr. Reuben Ottenberg, *Mount Sinai Hospital*
A SURVEY OF THE HEMORRHAGIC DISEASES WITH ESPECIAL REFERENCE TO BLOOD FINDINGS 289

September, 1918 U. S. ARMY NUMBER

PAGE

Major-General William C. Gorgas, *Surgeon-General U. S. Army*
CLINICAL RESEARCH IN UNITED STATES ARMY BASE HOSPITAL 313

Major Walter W. Hamburger, M. C., and **Major Herbert Fox, M. C.**
A STUDY OF THE EPIDEMICS OF PNEUMOCOCCUS INFECTIONS, AND STREPTOCOCCUS INFECTIONS, AND MEASLES, AT CAMP ZACHARY TAYLOR, KENTUCKY, AUTUMN, 1917, TO SUMMER, 1918 321

Contract Surgeon W. G. MacCallum, M. D., *Johns Hopkins University*
THE PATHOLOGY OF THE STREPTOCOCCAL PNEUMONIAS OF THE ARMY CAMPS..... 379

Lieutenant-Colonel Channing Frothingham, M. C., *Camp Devens, Mass.*
FUNCTION OF A BASE HOSPITAL IN A NATIONAL ARMY CANTONMENT..... 393

Major Edward H. Goodman, M. C.
RESULTS OF THE EXAMINATION OF 23,943 DRAFTED MEN BY THE CARDIOVASCULAR BOARD AT CAMP JACKSON, COLUMBIA, S. C..... 399

Major W. W. Herrick, M. C.
MENINGOCOCCIC PERICARDITIS, WITH REPORT OF 12 CASES. MEDICAL SERVICE OF BASE HOSPITAL, CAMP JACKSON, S. C..... 411

Lieutenant Morris H. Kahn, M. C., *Camp Zachary Taylor, Louisville, Ky.*
PAROXYSMAL TACHYCARDIA IN SOLDIERS, WITH REPORT OF CLINICAL AND POLYGRAPHIC STUDIES..... 427

Major E. P. Joslin, M. C., and **Major Homer Gage, M. C.**, *Camp Devens, Mass.*
POSTOPERATIVE PNEUMONIA..... 469

Major Harlow Brooks, M. C., *Camp Upton, N. Y.*
NEUROCIRCULATORY ASTHENIA. EPIDEMIC PAROTITIS AS A MILITARY DISEASE... 477

Major Francis W. Peabody, M. C., **First Lieutenant Joseph T. Wearn, M. C.**, and **Edna H. Tompkins**, *U. S. A. General Hospital No. 9, Lakewood, N. J.*
THE BASAL METABOLISM IN CASES OF THE "IRRITABLE HEART OF SOLDIERS"... 506

Major Lawrence Litchfield, M. C., *Camp Grant, Ill.*
NOTES ON THE DIAGNOSIS OF ACUTE INFECTIONS IN THE THORAX..... 517

Lieutenant-Colonel Joseph L. Miller, M. C., and **Captain Frank B. Lusk, M. C.**
EMPYEMA AT CAMP DODGE..... 536

Major Joseph C. Friedman, M. C., and **Captain Warren T. Vaughan, M. C.**, *Camp Sevier, S. C.*
SUBACUTE AND CHRONIC MEDIASTINAL COMPLICATIONS OF MEASLES..... 543
COMMENTS ON THE METHODS EMPLOYED IN PREVENTING MEASLES COMPLICATIONS 558

Major Russell L. Cecil, M. C.
PNEUMONIA AND EMPYEMA AT CAMP UPTON, N. Y..... 566

Major Charles L. Mix, M. C., *Camp Mills, L. I.*
ANTHRAX..... 587

Major Donald J. Frick, M. C.
CARDIOVASCULAR DISEASES AT CAMP BEAUREGARD, LA., FOR YEAR ENDING SEPTEMBER 15, 1918..... 601

Major J. M. W. Scott, M. C., *Camp Lee, Va.*
DRUG ADDICTION..... 607

First Lieutenant Macy L. Lerner, M. C., *Camp Jos. E. Johnston, Jacksonville, Fla.*
MARIE'S DISEASE. INFANTILISM. HYPERKERATOSIS. SUBCLAVIAN ANEURYSM.... 617

Major Thomas D. Coleman, M. C., and **Captain Emmet F. Horine, M. C.**, *Camp Hancock, Ga.*
THE CLINICAL SIGNIFICANCE OF CARDIAC MURMURS..... 621

Major Charles Spencer Williamson, M. C., *Camp Greenleof, Ga.*
THE PREVENTION OF COMMUNICABLE RESPIRATORY DISEASES..... 631

November, 1918 PHILADELPHIA NUMBER

PAGE

Clinic of Dr. Alfred Stengel, *University Hospital*
THE INFLUENZA EPIDEMICS OF 1889 AND 1918 645

Clinic of Dr. H. R. M. Landis, *University Hospital*
INFLUENZA AND SOME OF ITS COMPLICATIONS 671

Contribution by Dr. John B. Deaver
THE SURGICAL COMPLICATIONS AND SEQUELÆ OF INFLUENZA 699

Contribution by Dr. Randle C. Rosenberger
BACTERIOLOGIC STUDY OF SPUTUM IN THE RECENT EPIDEMIC 705

Clinic of Dr. Charles W. Burr, *Philadelphia General Hospital*
THE MENTAL COMPLICATIONS AND SEQUELÆ OF INFLUENZA 709

Contribution by Lieut. Eugene A. Case, M. C., U. S. N. R. F.
BACTERIOLOGY OF INFLUENZA 719

Contribution by Dr. J. Leslie Davis
NOSE, THROAT, AND EAR AFFECTIONS COMPLICATING OR FOLLOWING THE RECENT EPIDEMIC OF SO-CALLED INFLUENZA, WITH A VENTURED INTERPRETATION OF THEIR SIGNIFICANCE 731

Clinic of Dr. Maurice Ostheimer, *University Hospital*
INFLUENZA IN CHILDREN 743

Clinic of Dr. Thomas McCrae, *Jefferson Medical College*
SCIATICA 751

Clinic of Dr. Jay Frank Schamberg and Dr. Albert Strickler, *Jefferson Medical College*
INTRASPINAL THERAPY IN SYPHILIS 769

Clinic of Dr. Elmer H. Funk, *Jefferson Hospital*
CHYLOTHORAX 787
AORTIC ANEURYSM WITH ESOPHAGEAL RUPTURE 795
TUBERCULOSIS AND PREGNANCY 803

Clinic of Dr. Martin E. Rehfuss, *Jefferson Hospital*
MEDICAL TREATMENT OF BILIARY AFFECTIONS 815

Clinic of Dr. J. P. Crozer Griffith, *University Hospital*
DILATATION OF THE COLON IN CHILDREN, WITH ESPECIAL REFERENCE TO THE IDIOPATHIC FORM 829

Clinic of Dr. Maurice Ostheimer, *University Hospital*
FEEDING BABIES DURING THEIR SECOND YEAR 841

Clinic of Dr. Charles S. Potts, *Post-Graduate School, University of Pennsylvania*
CEREBRAL PALSIES OF CHILDREN 849

Clinic of Dr. Leon Jonas, *University Hospital*
DIABETES 861

Clinic of Dr. David R. Bowen, *Pennsylvania Hospital*
x-RAY DIAGNOSIS OF LUNG DISEASES 871

Contribution of Dr. S. D. W. Ludlum, *Philadelphia Hospital*
PHYSIOLOGIC PSYCHIATRY 895

Contribution by Dr. David Riesman
INFLUENZA—REMARKS UPON SYMPTOMS, PREVENTION, AND TREATMENT 903

January, 1919 NEW YORK NUMBER

PAGE

Clinic of Dr. S. W. Bandler, *Post-Graduate Hospital*
STERILITY IN WOMEN, WITH ESPECIAL REFERENCE TO ENDOCRINE TREATMENT OF SAME 921

Contribution by Dr. Walter Timme, *Neurological Institute*
A NEW PLURIGLANDULAR COMPENSATORY SYNDROME 959

Clinic of Dr. Walter W. Palmer, *Presbyterian Hospital*
PNEUMOCOCCUS ENDOCARDITIS 987

Clinic of Dr. T. Stuart Hart, *Presbyterian Hospital*
MITRAL STENOSIS AND AURICULAR FIBRILLATION. DIGITALIS—ITS USES AND DANGERS 1003

Clinic of Dr. Albert R. Lamb, *Presbyterian Hospital*
NON-HEMOLYTIC STREPTOCOCCUS ENDOCARDITIS 1027

Clinical Talk by Dr. Leo Buerger, *Mt. Sinai Hospital*
CYSTITIS: A DISCUSSION CONCERNING ITS DIAGNOSIS 1055

Clinic of Dr. Henry Rawle Geyelin, *Presbyterian Hospital*
CERTAIN ASPECTS OF THE MODERN TREATMENT OF DIABETES MELLITUS 1089

Clinic of Dr. Jesse G. M. Bullowa, *Willard Parker Hospital*
LOCAL EVIDENCE OF TONSIL INVOLVEMENT IN THE CAUSATION OF DISTANT OR SYSTEMIC DISEASE 1101
INFLUENZA OF HEAD AND CHEST 1115

Contribution by Dr. William H. Sheldon, *Cornell University Medical College*
THE HOSPITAL AS A HEALTH UNIT 1131

Clinic of Dr. A. S. Blumgarten, *Lenox Hill Hospital*
CASES ILLUSTRATING DIAGNOSTIC PROBLEMS 1145
I. PRIMARY MALIGNANT TUMOR OF LUNG 1145
II. CEREBROSPINAL SYPHILIS 1152
III. THREE CASES ILLUSTRATING PROBLEMS IN NEPHRITIS 1157
IV. TWO CASES ILLUSTRATING DIAGNOSIS OF AORTIC SYPHILIS 1168

Clinic of Dr. A. McI. Strong, *Presbyterian Hospital*
AURICULAR TACHYCARDIA IN CHILDREN: TWO CASES 1175

Clinic of Dr. Dana W. Atchley, *Presbyterian Hospital*
RENAL DISEASE 1187

Clinic of Dr. Eugene F. DuBois, *Cornell University Medical School*
THE BASAL METABOLISM AS A GUIDE IN THE DIAGNOSIS AND TREATMENT OF THYROID DISEASE 1201

Clinic of Dr. Willy Meyer, *Lenox Hill Hospital*
ADVANCED PULMONARY TUBERCULOSIS, A BORDERLAND DISEASE 1215

March, 1919 BOSTON NUMBER

PAGE

Clinic of Dr. Henry A. Christian, *Peter Bent Brigham Hospital*
CUTANEOUS PIGMENTATION, JAUNDICE, PALPABLE LIVER AND SPLEEN, AND ASCITES.. 1225
FIBRINOUS BRONCHITIS 1255

Clinic of Dr. John Lovett Morse, *Children's Hospital*
INFANTILE SCURVY 1273

Clinic of Dr. William P. Graves, *Free Hospital for Women*
CANCER OF THE UTERINE BODY AS A BORDERLINE CASE IN GYNECOLOGY 1289

Clinic of Dr. Charles J. White, *Harvard Medical School*
SOME COMMON ERRORS IN DIAGNOSIS AND TREATMENT 1301

Contribution by Dr. Fritz B. Talbot, *Massachusetts General Hospital* PAGE
THE RELATION OF DIET TO THE DEVELOPMENT OF CHILDREN, WITH SPECIAL REFERENCE TO THE TEETH 1333

Clinic of Dr. Channing Frothingham, *Harvard Medical School*
AORTIC ANEURYSM 1341

Clinic of Dr. George R. Minot, *Massachusetts General Hospital*
FOUR CASES WITH ENLARGED SPLEENS 1349
CASE I.—BANTI'S DISEASE 1349
CASE II.—BANTI'S DISEASE MISTAKEN FOR PEPTIC ULCER 1360
CASE III.—MYELOGENOUS LEUKEMIA WITH LOW WHITE COUNT 1366
CASE IV.—TYPICAL CHRONIC MYELOGENOUS LEUKEMIA 1371

Contribution by Dr. John B. Hawes, 2d, *Massachusetts General Hospital*
TUBERCULOSIS AND INFLUENZA 1375

Clinic of Dr. Frederick T. Lord, *Massachusetts General Hospital*
A PULMONARY DESTRUCTIVE LESION 1385

Contribution by Dr. H. Linenthal, *Massachusetts General Hospital*
THE RELATION OF THE CLINICIAN TO INDUSTRIAL MEDICINE 1403

Clinic of Dr. Lewis Webb Hill, *Children's Hospital*
NEPHRITIS IN CHILDREN 1419

Clinic of Dr. Franklin W. White, *Boston City Hospital*
IMPROVEMENT IN THE MEDICAL TREATMENT OF CHRONIC ULCER OF THE STOMACH AND DUODENUM 1431

Clinic of Dr. James P. O'Hare, *Peter Bent Brigham Hospital*
CHRONIC NEPHRITIS WITH EDEMA 1455

Clinic of Dr. Francis W. Peabody, *Peter Bent Brigham Hospital*
SOME LESSONS OF THE WAR IN THE FIELD OF CARDIAC DISEASE 1469

Clinic of Dr. George Cheever Shattuck, *Massachusetts General Hospital*
CASES FROM THE MALE MEDICAL CLINIC OF THE OUT-PATIENT DEPARTMENT 1489
CASE I.—CHRONIC PULMONARY TUBERCULOSIS AND ARTERIOSCLEROSIS 1489
CASE II.—WAR NEPHRITIS AND CHRONIC ADHESIVE MEDIASTINO-PERICARDITIS PROBABLE 1493
CASE III.—SYPHILIS, LESION OF AORTIC ARCH, PROBABLY SYPHILITIC; HEALED ULCER OF STOMACH OR DUODENUM 1498

Contribution by Dr. Arial W. George and Dr. Ralph D. Leonard
THE USE OF THE *x*-RAY IN THE STUDY OF MULTIPLE DIVERTICULITIS OF THE COLON. 1503

Contribution by Dr. M. J. Rosenau, *Harvard Medical School*
SOME FALLACIES IN THE DIAGNOSIS OF "PTOMAIN POISONING" 1541

May, 1919 BALTIMORE NUMBER

Clinic of Dr. Lewellys F. Barker, *Johns Hopkins Hospital* PAGE
FUNICULAR MYELITIS, OR COMBINED SCLEROSIS OF THE SPINAL CORD 1551

Clinic of Dr. Julius Friedenwald, *Mercy Hospital*
PERSONAL EXPERIENCE IN THE TREATMENT OF ULCER OF THE STOMACH 1575
VARIOUS TYPES OF ACHYLIA GASTRICA AS REVEALED BY THE REHFUSS METHOD OF FRACTIONAL ANALYSIS 1591

Contribution by Dr. John Ruhräh, *University of Maryland*
SOME OF THE ASPECTS OF EPIDEMIC INFLUENZA IN CHILDREN 1597

Clinic of Dr. Gordon Wilson, Medical Department, *University of Maryland*
FUNDAMENTALS IN THE TREATMENT OF PULMONARY TUBERCULOSIS 1605

PAGE

Clinic of Dr. Paul W. Clough, *from the Medical Clinic of the Johns Hopkins Hospital*
PNEUMOCOCCUS SEPSIS 1611

Clinic of Dr. Arthur L. Bloomfield, *Johns Hopkins Hospital*
THE CLINICAL DIAGNOSIS OF EPIDEMIC INFLUENZA 1635

From the Gastro-intestinal Clinic of the Johns Hopkins Hospital:
Clinic of Dr. Thomas R. Brown, *Johns Hopkins Hospital*
NOTES ON THE GASTRIC SIGNS AND SYMPTOMS IN DISEASES OTHER THAN THOSE OF THE STOMACH 1643

Clinic of Dr. John H. King, *Johns Hopkins Hospital*
GASTRO-INTESTINAL DISTURBANCES IN METABOLIC DISEASES AND DISEASES OF THE DUCTLESS GLANDS 1655

Clinic of Dr. E. H. Gaither, *Johns Hopkins Hospital*
THE RÔLE OF DIET IN TREATMENT OF DIGESTIVE DISEASES 1667

Clinic of Dr. Elmer B. Freeman, *Johns Hopkins Hospital (Out-patient Department)*
ESOPHAGOSCOPY AS AN AID IN THE DIAGNOSIS AND TREATMENT OF ESOPHAGEAL DISEASE 1691

Clinic of Dr. Frederick H. Baetjer, *Johns Hopkins Hospital*
THE ROENTGENOLOGIC SIGNS OF JOINT LESIONS IN CHILDREN 1703

Clinic of Dr. Louis Hamman, *Johns Hopkins Hospital*
INTRODUCTORY REMARKS TO A DISCUSSION OF DIABETES 1715
SEROUS MEMBRANE TUBERCULOSIS 1747
AURICULAR FIBRILLATION 1761

Clinic of Dr. Allen K. Krause, *Johns Hopkins Hospital*
A CASE OF MULTIPLE TUBERCULOSIS IN CHILDHOOD 1781

Index to Volume 2 1817

THE MEDICAL CLINICS
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VOLUME 2 NUMBER 1

CLINICAL LECTURE BY DR. FRANK S. MEARA

At Cornell University Medical College

HYPERPIESIA OF CLIFFORD ALLBUTT (ESSENTIAL HYPERTENSION)

Differentiation from Interstitial Nephritis and Arteriosclerosis. Possibility of Mistaking End-products of Hypertension. Pioneer Work in Division of Groups. Theodore Janeway's Subdivision of Hypertensive States. Division of Alfred Stengel. Disease Entity of Clifford Allbutt, Hyperpiesia; Essential Features; Course; End-results; Age Incidence; Early and Late Manifestations; Therapy; Prognosis. Contrasting Cases.

When a patient offers the history of a long-standing high blood-pressure he will be pronounced almost inevitably a case of chronic Bright's disease or of arteriosclerosis. This diagnosis will be in accordance with the generally accepted instruction of the last generation.

If the patient's urine shows traces of albumin and casts, hyaline or granular, the diagnosis will be chronic Bright's unless the physician, shrinking from pronouncing the doom of the patient or puzzled at the apparent well-being of a man or woman entertaining so dire a condition, is led to call it chronic interstitial nephritis, although he knows authority would charge him with making a discrimination without a difference; still he feels a vague comforting difference in this discrimination.

If the urine of the patient with chronic hypertension is innocent of any deviation from the normal, or if the attention of the

physician is fixed by marked thickening of palpable arteries, or the patient has had apoplectic attacks, major or minor, he will be considered a case of arteriosclerosis. And so, indeed, he is. But the diagnosis carries with it in the mind of the diagnostician the connotation that the arteriosclerosis was the essential and causative factor in the whole disturbance, which it is not. By the more careless the hypertension may be overlooked entirely and the diagnosis established in terms of the end-products of the process, cardiac disease or apoplexy.

The observant clinician soon noted that there were not a few cases that did not fit well into either one or the other groups into which chronic hypertensive cases were divided. Cases that should fit snugly into the frame labeled chronic Bright's disease failed to show any of the urinary findings considered essential to Bright's disease, and it became necessary to conceive of these as in the prealbuminuric stage of Bright's disease (Mahomed). Cases that ought to fall under the category of arteriosclerosis failed to demonstrate any palpable or visible artery in a sclerotic condition, so the term "latent arteriosclerosis" (Von Basch) was coined, meaning thereby that an arteriosclerosis did actually obtain in a vessel or group of vessels which play a rôle in the maintenance of a normal blood-pressure—*e. g.*, the splanchnic vessels or perhaps the cerebral vessels—while others imagined a presclerotic stage in the production of arteriosclerosis (Huchard). This latter conception was pioneer work that thinned the woods.

Students of the subject in our own country were illy satisfied with the old division. Theodore Janeway, studying the rich material of his father's private practice and his own, felt the necessity of splitting off another group which he termed "chronic hypertensive cardiovascular disease," a name as good as another for what I am about to describe. I would recommend to you these studies of Dr. Janeway on hypertensive states.

My own attention was first called to this group, distinct from Bright's or arteriosclerosis as I had visualized them, by Dr. Alfred Stengel,[1] who described vividly a group of hypertensive cases standing in striking contrast to the companion picture he

[1] Jour. Amer. Med. Assoc., October 24, 1914, p. 1463.

drew of primary interstitial nephritis. This group became clearer cut as they multiplied upon my files. Its position as a distinct disease entity we owe to Clifford Allbutt, Regius Professor of Physic in the University of Cambridge, England, more than to any other man. A lifelong student of cardiovascular disease and a prolific contributor to the literature on the subject, he gathered together the abundant but scattered data on the subject in a veritable *magnum opus* published in 1915 under the title of "Diseases of the Arteries including Angina Pectoris," in which it appeared under the designation of "Hyperpiesia."

By hyperpiesia he defined a state, condition, or disease whose essential feature and earliest manifestation is hyperpiesis or elevated blood-pressure. It is the condition sometimes referred to as essential or primary hypertension, and is the group designated by Janeway as "chronic hypertensive cardiovascular disease." In the first number of these CLINICS Mosenthal and Hamman each discussed this entity.

The cause of the heightened blood-pressure is not yet known. In the course of time it is followed by cardiac hypertrophy and by arteriosclerosis. It is essentially chronic in its course. The end-result is either cardiac failure or an arterial accident, cerebral or coronary, in the vast majority of cases, and the patients rarely, if ever (and it is my experience, never), die of uremia.

Observe these salient features of the condition. It occurs especially in people of apparently robust health. For months or, rather, for years neither they nor their friends suspect aught is wrong with their health. These patients are usually of ruddy complexion, stocky build, plethoric habits, active temperament, live men and women. To them more than to others your greeting of "How well you look!" rings with conviction. These people enjoy life and the good things of life. They are endowed with hearty appetites and indulge them freely. They are gourmets rather than gormands, though often fairly earning the latter title. They are not heavy drinkers, as a rule, but often use alcohol to add to the pleasures of the table. There are, however, many exceptions to these statements.

When symptoms occur that elicit the attention and concern

of the patient, the hyperpiesis has obtained for a long period of time—years. Most of these patients are, at the time of the development of their symptoms, in late middle life, a decade older than the true Bright's, primary interstitial nephritis, which occurs in early middle life, and a decade younger than the cases of senile arteriosclerosis, senile myocarditis, or cardiosclerosis and arterscleratic kidney.

Life insurance examinations, however, and the routine use of the sphygmomanometer bring to us the fact that this condition begins, certainly in a large percentage of the cases, if not in the majority, in early middle life. The earliest symptoms noted are increasing dyspnea on exertion, marking the beginning break in cardiac compensation, or precordial pain or a sudden onset of pulmonary edema, or the first symptoms are referable to the cerebral vessels, slight shocks or warnings of their early advent, or it may be increasing nervousness, irritability, fatigue, and loss of concentration. But now the process is far advanced. Insidiously the cause has been operative for years, and nobly and efficiently the heart has responded to ever-increasing demands and made no appeal for help. I shall cite to you a typical case.

Mrs. F. H., fifty-one years of age, became aware of high blood-pressure two years ago. The reading was 230 m.m. Hg. in systole, and has hovered about that figure since unless the patient is kept some time in bed, when it falls somewhat. A year later she had a cerebral accident characterized by mental confusion, difficulty of speech, and some numbness in the right arm. This cleared up fairly quickly. After an interval of another year she had a repetition of aphasia, which now, after two weeks, is still obvious in her hesitation in choice of words. The patient is thick-set, a well-developed woman of firm tissues and *florid complexion.* The pupils react to light and accommodation. The *eye-grounds show tortuous veins, small arteries,* and, *near either disk, a small hemorrhage.* The *heart* is moderately *hypertrophied.* The right border is 3 cm. from the midsternum in the fourth space, and the apex is 10½ cm. from the midsternum in the fifth space. Apex is a little thrusting;

sounds of good quality, no murmurs, no arhythmia. *Blood-pressure* 200/120. Wassermann is negative.

Renal Functions.—The *concentration tests* (Mosenthal) show a specific gravity varying from 1016 to 1030 and the twelve-hour night collection amounted to 565 c.c.

The *phenolsulphonephthalein test* gave an output of 65 per cent. of the dye in two hours.

The *blood constituents* amounted to 1 mg. of uric acid in 100 c.c.; 18.5 mg. of urea nitrogen in 100 c.c.; 3.4 mg. of creatinin in 100 c.c.

Urine showed a trace of albumin and no casts.

It will be seen, then, that no test gave evidence of kidney impairment in a clinical sense. The trace of albumin and the very trivial nocturia are due to arteriosclerotic changes in the renal vessels, as will be later discussed.

Age.—As already stated, these cases are discovered in later middle life in the majority of cases, but are by no means confined to this period. Of 50 of my cases, the ages when observed by me were distributed by decades as follows:

To 10 years	1 or 2	per cent.
10–20 "	0	
20–30 "	0	
30–40 "	2 or 4	"
40–50 "	20 or 40	"
50–60 "	14 or 28	"
60–70 "	7 or 14	"
70–80 "	6 or 12	"

56 per cent. fell between 45 to 55 years.
68 " " " 45 to 60 "

The youngest patient in this group, G. F., was eight and one-half years of age at the time of observation. He had had intense headaches since the age of five years. His blood-pressure was 210/150, and yet, to the casual observer, he appeared in good health, had a high color, and was an active, energetic boy. The day before I saw him he carried off the honors in a battle royal in the street. His heart was much hypertrophied, the left border being 10 cm. from midsternum in the fifth space. Transitory edemas of the feet bespoke faltering compensation.

His eye-grounds showed arteriosclerosis of the retinal vessels, hemorrhage, and some exudate of the type of an arteriosclerotic retinitis.

Urine examination was as follows: Specific gravity 1010, heavy trace of albumin, and no casts. Phthalein test gave 42 per cent. the first hour, 21 per cent. the second; total of 63 per cent., a normal figure. His urea-nitrogen in the blood was 20 mg. per 100 c.c., a normal figure. These tests were later repeated in the laboratory of St. Luke's Hospital in this city, with practically identical results. He had later a hematuria which was repeated, and two months later a hemorrhage from the bowel. This was followed by a mesenteric thrombosis, a perforation of the intestine in two places, peritonitis, and death.

It is understood, of course, that occurrence at so early an age is rare, but this case illustrates how catholic in its choice the affection may be. Its incidence in old age is common enough, as my figures show, though in most instances it must be assumed that the trouble began a number of years before. While a systolic pressure of 200 or a little less is common enough among patients seventy years or over, the excessively high pressures occur among those in later middle life.

As I have said, many cases are discovered accidentally in the course of a routine examination; one, I recall, in a woman suffering from lumbago whose blood-pressure of 210/110 had never been suspected. Once more I reiterate that the common diagnosis in these cases is Bright's disease, chronic interstitial nephritis, cardiorenal disease, with the implication that the kidney is profoundly altered both in structure and in function; especially is this so if attention has been attracted to the trace of albumin and to casts.

Clinically, however, these cases are remote from Bright's disease. As a rule, when the diagnosis is made, the patient is a decade older in hyperpiesia than in Bright's disease. Again, when the diagnosis is made, cachexia is already noted in Bright's; it is a late phenomenon in hyperpiesia. The course is a slow one, a relatively benign one in hyperpiesia; much more hurried and malignant in Bright's. Most important of all, uremia is

not seen, or but rarely (in none of my cases), in hyperpiesia; it is the characteristic episode in Bright's. Albuminuric retinitis occurs in Bright's and not in hyperpiesia. Finally, tests of renal function determine a decompensation in Bright's and a practically unimpaired function in hyperpiesia.

The pathologic histology of the kidney in hyperpiesia has not yet been sufficiently worked out. That many of the kidneys of long-standing hyperpiesia are profoundly altered in structure is not to be doubted. Many are small, shrunken, and have adherent capsules. Such kidneys have been classified as chronic interstitial nephritis, granular kidney, and conceived to be identical with the kidneys of clinical Bright's. Such terminal kidneys are so altered architecturally that able pathologists frankly acknowledge that the sequence of pathologic changes that eventuate in the shrunken kidney is obliterated in the process.

It is probable, in primary interstitial nephritis, the granular kidney of Bright's, that the early changes were inflammatory, with early implication of the intertubular and afferent vessels of the glomeruli with thrombosis, due to the unknown toxic substance that is responsible for the uremic manifestations; while in the kidneys of hyperpiesia the process is replacement of nobler tissue, parenchyma starved slowly by the insufficient blood-supply of the sclerotic renal vessels, by connective tissue, and never at any stage the seat of inflammation. It is entirely possible that all reserve tissue may be lost and the kidney wasted below the threshold of competency; but this is rare, and even then, I believe, gives rise to a set of symptoms different from uremia, unless we grant the so-called "chronic uremia," characterized by progressive stupor and coma, but not by twitchings, convulsions, or albuminuric retinitis.

Here is the history of a patient sent to me as a case of Bright's disease:

H. W. B. was fifty-six years of age, a business man. His hypertension was first noticed three to four years previous, that is, at the age of fifty. His blood-pressure when I saw him was 210/110 and his urine had a specific gravity of 1022, showed a

faint trace of albumin, and a few hyaline casts. On the basis of his hypertension and urinary findings the diagnosis of Bright's disease had been established.

His heart was much hypertrophied, the lower border 16½ cm. from midsternum in the fifth space, and there was a faint systolic murmur over the second right space attributable to an atheromatous aorta. His palpable arteries were thickened, but the retinal vessels and the eye-grounds were unchanged.

Renal tests were as follows:

Concentration test, 2-hour portions varying from 17 to 66 c.c., showed a specific gravity of 1021 to 1034 (normal); night urine 520 c.c. (very slight nocturia); phthalein, 44 plus 16 equals 60 in two hours (normal).

Blood constituents: Uric acid, 2.8 mg. per 100 c.c.; urea nitrogen, 16.5 mg. per 100 c.c.; creatinin, 4.5 mg. per 100 c.c.

Repeated by another chemist on another occasion: Uric acid, 2.1; urea-nitrogen, 24.0; creatinin, 0.2.

All of these are normal and agree, except the creatinin, the most difficult to determine by the colorimetric method. Once he had had an attack of cardiac insufficiency, coming on abruptly. He had never had symptoms referable to his kidneys.

Here, then, we have a typical case of hyperpiesia, living under the sword of Damocles in the shape of uremia. Some of these cases, however, have had a history of nephritis in the past; among my patients most commonly during a pregnancy. It is a nice question to answer whether we are dealing with a contracted kidney, secondary to an acute productive nephritis of pregnancy, or with a hyperpiesia in a woman who had a nephritis from which she recovered, or both conditions in the same patient. Absence of uremic symptoms and retinitis, with normal functional tests, should, in my opinion, strongly favor hyperpiesia.

The following case illustrates hyperpiesia in a woman with the history of nephritis in pregnancy:

Mrs. E. I., fifty-one years of age, seen first in 1914. Hypertension, 245/130. She had had a nephritis with the last pregnancy, fifteen years before. The heart showed a moderate

grade of hypertrophy. The retinal vessels were negative. Phthalein 60 per cent. in two hours. Blood uric acid 1.2 mg. per 100 c.c. Non-protein nitrogen 18 mg. per 100 c.c. All these are normal figures.

In 1917: Blood-pressure 230/130. No change in heart noted, but retinal vessels now show sclerotic changes. Phthalein 46 plus 21 equals 67. Blood uric acid 4.14 mg. per 100 c.c. Urea nitrogen 14.3 mg. per 100 c.c. There had been no accidents of any kind in the meantime and, though so high a blood-pressure obtained over all this period, the only changes noted were sclerosis of the retinal vessels and a beginning retention of uric acid.

The case is not so clear in the following:

Mrs. D. B., forty years of age. Blood-pressure 200/120. Had a nephritis with first child, some fifteen years before. A second pregnancy was interrupted because of nephritis. Very recently she had had a cerebral accident while straining at stool, characterized by numbness in the left hand and elbow, and some difficulty in selecting her words in conversation. Her heart was hypertrophied; there was a systolic murmur at the apex and one over the second right space. The retinal vessels showed sclerotic changes. Urine, 1017; trace of albumin and a few hyaline casts. The phthalein output was 33 plus 18 equals 51 per cent. Blood uric acid, 5.4 mg. per 100 c.c. Urea-nitrogen, 25 mg. Creatinin, 1.19 mg. Two months later her uric acid was 9.7 mg.; urea-nitrogen 29.3. She was put on a rigid dietetic régime and one month later her uric acid was 1.82 mg. and urea-nitrogen 24.5.

The retention in this case seems greater than could be accounted for by the condition of the circulation, that is, passive congestion of the kidneys, and it may well be that we are dealing with a hyperpiesia in a patient with kidneys already damaged by a previous nephritis.

The following case will show how cautious one must be in making a diagnosis of Bright's disease, even when renal tests demonstrate functional distress and certain symptoms invite to a hasty diagnosis of uremia:

The patient was seventy-two years old, a stout, excessively

florid man, who never had put any limitations on the pleasures of life. He was a hearty eater and indulged freely in alcoholic beverages, rather as a gastronome than as a confirmed alcoholic, a gourmet, and a gormand. He was an out-of-doors man, and when he consulted me was on his way South to spend the winter on his yacht.

His blood-pressure was 200/80. The heart showed a tremendous hypertrophy; the left border was 18 cm. from mid-sternum. There was a systolic murmur over the second right space, atheromatous aorta. The eye-grounds showed some white patches of exudate, arteriosclerotic retinitis.

Three months before he had been found in a coma and was seen by an eminent specialist, who made a diagnosis of uremic coma. But he promptly came out of this coma, got up and about, and manifested no further symptoms of uremia.

His urine, when he consulted me, was 1017, showed a massive precipitate of albumin and many hyaline and granular casts. The phthalein output was 5 per cent. in two hours. The blood uric acid was 2.05 mg. per 100 c.c. (normal); the urea-nitrogen 42.5 mg. per 100 c.c.; the non-protein nitrogen 78.2 (over 100 per cent. increase); and the creatinin 4.8 mg. (a very marked increase).

I considered his kidneys perilously compromised, and urged rest and the usual régime. He utterly scorned my advice, went on his trip, and fourteen months later reported himself as in good shape, never having had "another attack." Two and a half years later I gathered this history: He went South the winter I saw him and again the next year, 1916; to California in June, 1916, again in the fall; motored across the continent in May, 1917, motored again to Los Angeles in thirty days, returned to Chicago, and from there eastward to New York in four days, and until two weeks ago, June, 1918, nothing had happened to him, and then he had a slight shock. Does this look like Bright's disease?

Here is a typical hyperpiesia with renal decompensation from passive congestion in an arteriosclerotic kidney; having had a cerebral hemorrhage in 1915 called "uremic coma" and three years later another cerebral hemorrhage. He is now seventy-

five years of age and no more obedient to medical advice than formerly.

Renal Findings.—Of 50 cases of hyperpiesia taken for analysis, the findings were as follows:

Urine:

Specific gravity.	*50 cases.*	*Of observed.*
1010 and under	3 or 6 per cent.	6.8 per cent.
1011 to 1020	24 " 48 "	54.5 "
1021 to 1030	16 " 32 "	36.3 "
1045 (diabetic)	1 " 2 "	
	6 " 12 "	not observed.

It will be seen that the characteristic low specific gravity of Bright's did not obtain.

Albumin.		*50 cases.*	*Of observed.*
In 8 cases	16 per cent.	None.	17 per cent.
In 9 "	18 "	Very faint trace.	20 "
In 19 "	38 "	Trace.	41 "
In 10 "	20 "	Heavy trace.	22 "
In 4 "	8 "	Not observed.	

In about one-third practically no albumin by ordinary tests. In another third a trace. In less than one-third a heavy trace.

I am convinced that the trace of albumin is due to the arteriosclerosis in the kidney and the heavy trace to passive congestion in the kidney. The first third would have been classified by Mahomed as in the prealbuminuric stage of Bright's disease.

Casts.		*In 50 cases.*	*Of observed.*
These were nearly always hyaline, occasionally granular.			
19 cases	38 per cent.	None.	42.2 per cent.
19 "	38 "	Few.	42.2 "
7 "	14 "	Many.	15.5 "
5 "	10 "	Not observed.	

Phthalein test (*Phenolsulphonephthalein*):

		Observed.	
5 cases	10 per cent.	(13.9) in two hours.	70–80 per cent.
11 "	22 "	(30.6) " "	60–70 "
8 "	16 "	(22.2) " "	50–60 "
6 "	12 "	(17.6) " "	40–50 "
5 "	10 "	(16.6) " "	30–40 "
1 case	2 "	(3.0) " "	5 "

Thus, two-thirds were normal. In none of the cases did I find the low figures so ominous in uremia, except in one whose history I have just detailed. In 14, or 28 per cent., the observation was not made.

Of the 32 cases noted, 26, or 81 per cent., passed the most of the dye in the first hour; 2, or 6.4 per cent., the same in each hour, and 4, or 12.8 per cent., most in the second hour.

Blood Determination.—*Uric Acid.*—This was observed in 43 cases.

Of the observed:

24 cases, or 56	per cent., showed	3	mg. or less per 100 c.c. blood.					
7 " 16	" "	3– 4	mg. per 100 c.c. blood.					
4 " 9.3	" "	4– 5	"	"	"			
5 " 12	" "	5– 6	"	"	"			
1 case 2.3	" "	6– 7	"	"	"			
1 " 2.3	" "	7– 8	"	"	"			
1 " 2.3	" "	9–10	"	"	"			

44 per cent. noted showed some retention.
56 per cent. noted were normal.

According to Myer and Fine uric acid is the metabolite earliest retained. I found this by no means constant; but I did find that it was more commonly retained than the others.

Urea-nitrogen was observed in 42 cases.

Of the observed:

20 cases, or 47.6	per cent., showed	20	mg. or less in 100 c.c. blood.					
13 " 30	" "	20–25	"	"	"			
5 " 12	" "	25–30	"	"	"			
1 case 2.4	" "	30–35	"	"	"			
1 " 2.4	" "	35–40	"	"	"			
1 " 2.4	" "	40–45	"	"	"			
1 " 2.4	" "	45–50	"	"	"			

Normal is taken at 20 mg. or less; 20–25 mg. as debatable.

We thus have in these two groups 77.6 per cent. normal and 21.6 per cent. of frank retention. Note that only 4 run above 30 and that 48 mg. was the most.

Non-protein nitrogen in the blood was determined in 12 cases.

c. blood.
"
"
"

of which
. or under

was done in 4 only, as most of these cases antedated the method. Nocturia occurred in all. Slight limitations in concentration in 2. Polyuria in 1.

It will be noted that striking retentions occurred in very few, if any.

My cases of hyperpiesia now number over 250, which, unfortunately, I have not had time to collate; but the results, I am sure, are very much the same throughout. In all the 250 cases or more I have not seen any case die of what I believe was uremia, though it is possible that one did. The clinical picture of all this larger number was not that of Bright's disease. The renal decompensations have rarely been of marked degree, and when treatment was directed toward improvement in circulation and functional rest the improvement has been beyond anything I have ever witnessed in Bright's disease.

I cite a recent case not included in the series of 50. This man of fifty years had a blood-pressure of over 300/190. He had a hemiplegia. He was a physical type of the hyperpietic, overweighted, stocky, and florid. The heart was enormously hypertrophied and a systolic blow had developed at the apex.

The renal functional tests showed phthalein output of 15 in two hours; uric acid in blood 6 mg. per 100 c.c.; urea-nitrogen 49 mg.; creatinin 7 mg. Wassermann negative. In four weeks under restricted diet and digitalis his blood-pressure was 240/130; uric acid, 1.57 mg.; urea-nitrogen, 20 mg.; creatinin, 3.04 mg.

I hope I have impressed upon you that this group of cases so commonly called Bright's disease are not such; that the renal decompensation is slight, the phthalein depressed to a greater degree than the metabolites are retained, as one would expect with passive congestion, that improved circulation restores renal compensation to an astonishing degree even in kidneys that have undergone much shrinking from arteriosclerotic changes, and that uremia must be a rare phenomenon in this group.

How, then, do they die?

1. By an arterial accident.
2. By cardiac failure.

We have seen that when these hypertensive cases are not called Bright's disease they are termed "ARTERIOSCLEROSIS." It has been widely assumed that arteriosclerosis was responsible for the increase of blood-pressure; but now we are coming to believe that it is the result of hypertension rather than the cause, where the association between the two exists.

Allbutt has illuminated this subject as he does most with which he deals. He divided all arteriosclerosis into two groups:

1. That form found in elderly people, giving rise to thickened, tortouus, and strikingly calcified arteries, not associated with hypertension to any considerable degree and not associated with cardiac hypertrophy; that form of atherosclerosis commonly called senile, or, as he has termed it, "decrescent" or "involutionary," both of which terms we associate with the waning processes of age.

2. A form whose pathology is in many respects like the first, but giving rise, as a rule, to thick, leathery arteries, fibrotic, only occasionally calcified (though forms 1 and 2 may coincide), associated with hypertension, whether that of essential or primary hypertension—*i. e.*, his hyperpiesia, or that of Bright's

disease, and, as he convincingly argues, due to the excess of blood-pressure itself. This form of arteriosclerosis is, of course, associated with cardiac hypertrophy.

3. Toxic arteriosclerosis, occurring after infections, notably syphilis, but also typhoid, scarlet fever, rheumatism, influenza, and other diseases more rarely. This is an affection of the middle coats especially, the familiar pathology of lues. It is important to note that this form of arteriosclerosis is not associated with hypertension of any import, and consequently not associated with cardiac hypertrophy. You will again and again find statements of syphilis as the cause of hypertension. These are incorrect, though, of course, lues may occur in a hyperpietic.

Our subject is concerned with the second form only. Now the incidence of arteriosclerosis is more or less haphazard and patchy. It may affect many territories, like the spleen, without giving rise to any disturbance, or it may affect one or more important areas, with death as the result. The kidneys are in a large percentage of cases the seat of arterial changes, in advanced cases causing a starvation and shrinkage of kidney substance with very slow sacrifice of reserve, but rarely, and that on the occasion of circulatory impairment and consequent passive congestion, giving rise to frank decompensation, and we have seen how amenable this state is to proper treatment in contrast to true Bright's. Much more rarely than has been sometimes assumed the splanchnic vessels are seriously involved. We have seen in the case of the young child how a thrombosis of one of the mesenteric vessels caused ulceration, perforation, peritonitis, and death.

Two territories are of prime importance, the coronary vessels and the cerebral vessels. I will speak first of the latter. Apoplexy is the classical expression of the diseased state of the cerebral vessels, and hemiplegia its most readily recognized manifestation.

F. W. (male), sixty-six years. Blood-pressure when seen 200/110. Highest noted 240. Hypertension first noted three years before. Slight stroke April, 1916. Second stroke September, 1916. Fatal stroke one year later in 1917. Renal

tests practically normal. Phthalein 18 plus 24 equals 42. Uric acid 3.22 mg. Urea-nitrogen 21.5.

C. W. B. (female), forty-eight years. Blood-pressure 230/110. First noted one and a half years before. Confusion of speech and sudden weakness. Six weeks later hemiplegia. Phthalein 46 plus 26 equals 72. Uric acid 3.37 mg. Urea-nitrogen 14 mg.

J. C. F. (male), sixty-three years. Blood-pressure 240/130. Slight hemiplegia. Phthalein 27 plus 14 equals 41. Uric acid 3.55 mg. Urea-nitrogen 21.5 mg. Excellent health two years later.

All three had arteriosclerotic changes in the retinal vessels. When one considers that these vessels are offshoots of the cerebral vessels, one understands what prognostic significance changes in the retinal vessels affords; for while the patchy incidence of arteriosclerosis permits of changes in the retinal vessels without involvement of cerebral vessels elsewhere, nevertheless these changes make it highly probable that branches of cerebral vessels elsewhere are implicated. You do not have to be skilled ophthalmologists to make useful observations in this field, and I, for one, contend that the general practitioner should carry his stethoscope in one pocket and an ophthalmoscope in another, and use both on every case examined.

The criteria of changes that I have adopted are:

1. Changes at arteriovenous crossings. Displacement (crooking) of veins at arterial crossings.

Obstruction or obliteration of veins at arterial crossings.

These are most important.

2. Tortuosity of arteries, especially the small branches.

3. Central light reflex—the bright glistening streak along the center of the arterial wall. This should be considered only in smaller branches and has especial value if the light streak is interrupted in dots.

4. Irregularity in the lumen of the arteries.

5. Retinal hemorrhages.

6. Arteriosclerotic retinitis.

Of course, this list is not exhaustive, but will answer the purpose of the general practitioner.

Arteriosclerotic retinitis is among the newer concepts and most important to grasp. It consists of the changes constituting the picture of arteriosclerosis plus exudates which are usually seen as small dots, spots, or areas. Not infrequently they occur in groups between the macula and disk. They often occur in one eye only. A retinitis in the presence of hypertension is fairly sure to be diagnosed an albuminuric retinitis by the general practitioner. B. Foster Moore, to whom I am indebted for these remarks and whose article on this subject in the Quarterly Medical Journal, Vol. 10, Nos. 37 and 38, I earnestly recommend to you, differentiates the two in these terms:

In sclerosis the changes in the vessels are commonly more marked in proportion to the exudates than a renal retinitis. "Retinal hemorrhages tend to be smaller and more scattered than in renal retinitis. The retinal exudates . . . are to some extent distinctive in appearance and arrangement. Patches of soft edged exudates (wooly patches, cotton-wool patches, snow bank, or cumulus cloud exudate) are rare in arteriosclerotic retinitis, and when they occur are probably evidence of beginning renal insufficiency. General retinal edema does not occur. The star figure may be present in either case."

A large percentage of arteriosclerotic retinitis remains unilateral. This is seldom the case in renal retinitis.

Of the 50 cases analyzed, the condition of the retina was noted in 36.

Arteriosclerosis was found in 21, or 58 per cent. Hemorrhage occurred in 6, or 16.6 per cent.; exudates in 2 cases; 4 more cases showed signs of arteriosclerosis of indefinite character. If these were included, one would say that two-thirds of the cases of hyperpiesia showed arteriosclerosis of the retinal vessels.

Other expressions of cerebral accidents of minor character are slight, such as passing disturbances of speech, often not amounting to aphasia, but a confusion or difficulty in choice of words; *e. g.*, one of my patients whose pressure varies between 155 and 200 had at table an attack of confusion and bewilderment, accompanied by loss of memory of names of servants who had been in the family over twenty years, that rendered her almost

hysterical. This passed off in a few minutes and has not recurred in three years.

Mental lag may be an early manifestation, loss of wonted initiative, snap, and go; or it may be unaccustomed irritability and nervousness, carelessly called "neurasthenia." Among the older patients frank mental deterioration is more obvious. Convulsive seizures, epileptiform in character, may occur. I have had 4 cases in the arteriosclerosis of elderly people. Three out of four have been in the senile type of arteriosclerosis, associated with low blood-pressure. This seems to be the rule, according to Allbutt. Stengel has discussed this group. The one case with hypertension was in a man aged sixty-four years who had three attacks in his sleep in the course of five months. His blood-pressure was 200/100; arteriosclerosis of the retinal vessels. Urine 1015, no albumin, no casts; phthalein 34 plus 23 equals 57; blood uric acid 4.9 mg., urea-nitrogen 17 mg. per 100 c.c. It will be seen that the kidney was not involved. These attacks might carelessly be attributed to uremia.

Two of these 50 cases died from an arterial accident. If death is not due to this cause it is usually a cardiac death.

Cardiac Disease in Hyperpiesia.—So prominent are the cardiac difficulties in many cases of hyperpiesia that the presence of hypertension or its rôle in the drama is overlooked, and the condition diagnosed as cardiac disease, as myocarditis, angina pectoris, etc.

Two conditions contribute to cardiac changes in hyperpiesia, especially (1) increased work entailed by increased pressure, and (2) changes in the coronary vessels of a sclerotic character affecting the nutrition of the myocardium.

Cardiac hypertrophy is constant in hypertension, as might be anticipated. This hypertrophy is unquestionably compensatory; but that the quality of such a musculature is as good as the normal is more than doubtful. A veritable cors bovinum does not mean an increase in efficiency in proportion to increase in weight. Impairment of the coronary circulation must mean malnutrition, degeneration, increase in connective-tissue ratios, disturbances in rhythms, and probably far more subtle changes of a physico-

chemical nature that waits upon the future for elucidation; but which is demanded in many cases of so-called myocarditis and senile heart, whose failure of function unto death displays such a paucity of pathologic change in structure at the autopsy table. I am in accord with Christian's observations and teachings on this subject.

Pulmonary Edema.—This is a not uncommon accident in hyperpiesia; indeed, it is a phenomenon peculiarly associated with left-sided heart failure. It would take us too far afield to discuss its causation in detail. Perhaps the most appealing explanation is an accumulation in the pulmonary circuit, due to disproportion in the two sides of the heart, an efficient right heart forcing blood into the pulmonary arteries, an inefficient left heart emptying the pulmonary veins. However, this fails to explain to me the sudden onset, the rapid clearing up, and its occurrence without physical exertion or mental agitation to account for it, as is the case in many instances. Of course this may be the cause of death. On the other hand, it is surprising how many attacks of this kind, each of which seems alarming, the patient may survive. Here is one in this series of 50 cases, a man of fifty-seven years, blood-pressure 200/110, with normal blood constituents, who has had several attacks of pulmonary edema. The tic-tac quality of his heart sounds pronounced his needs, and with the aid of digitalis he passed the next year with only one slight attack. Several of my patients have had these attacks.

Angina pectoris is fairly common among the cases of hyperpiesia. Accepting any of the common explanations of the phenomenon, one would expect angina to be frequent in these laboring hearts, the seat of probable coronary sclerosis and associated with atheromatous aortas. And yet, in my experience, the angina in these hypertensive cases has been more benign in its course than in the low blood-pressure cases of senile arteriosclerosis. Indeed, I have come to dread the cases whose pains and distribution of pains are classical, but whose hearts seem normal in all respects to an examination and whose blood-pressure is normal.

Six of my series, 12 per cent., had angina with as yet, so far

as I have been able to trace them, one death only. The fatal case when I saw him was sixty years old. Blood-pressure 178/80, blood constituents normal, heart grossly incompetent. Death occurred three weeks later.

Among the non-fatal cases is a physician of sixty-five years. Blood-pressure 195/100. Practically normal renal tests. Enormous hypertrophy with evidences of conduction defects. Suffering from frequent and crippling attacks, obliging him to give up his practice, and yet after many months resisting their fatal effects.

Another of forty-five years, having gout and, except for blood uric acid, which at the time of a gout attack rose to 9.1 mg., showing normal renal tests. Blood-pressure 225/140, unable to walk a block without some anginal pains, but, observing these limitations, remains relatively comfortable. Wassermann reaction negative.

Here another, a woman of fifty-two years. Blood-pressure 265/145. Renal tests normal. She is pitifully affected, pains severe, and occurring continuously even at complete rest, necessitating so much drug relief that at last it is hard to estimate the degree of suffering as against drug craving, and this has gone on month after month, with no threat of an attack of fatal severity or sign of cardiac failure.

All of the cases cited evidenced involvement of the root of the aorta; hence possible involvement of the coronaries, the usual explanation of angina, and fortifying Allbutt's idea of implication of sensory nerve plexuses at the root of the aorta as the cause.

Paroxysmal Dyspnea.—Somewhat akin to angina pectoris is another reflex nerve storm, paroxysmal dyspnea. I have 2 cases in my series. It consists of a most intense and abrupt dyspnea of agonizing character, equalled by nothing that I have witnessed unless it was a similar attack I once saw precipitated by an injection of diphtheria antitoxin (horse-serum) in an asthmatic sensitized to horse emanations, which well-nigh proved fatal. Like this anaphylactic reaction, paroxysmal dyspnea is caused through a violent contraction of the bronchioles and is attributed by

Longcope,[1] whose most excellent study of this condition I recommend to you, to an involvement of these same nerve plexuses at the root of the aorta in an aortitis.

This patient, fifty-three years old, had had these attacks for six months, latterly many in a day. Blood-pressure 220/150. Angina accompanied them. He died not long after.

The second case was in a woman of seventy years. Blood-pressure 280. I did not witness these attacks.

Cardiac irregularities are of frequent occurrence. The most common are the premature systoles, the importance of which has diminished in my estimation almost to the vanishing point. I have one case (not a hypertension) in whom a strip of an electrocardiogram showed premature systoles to frankly outnumber the normal complexes, with no evidence of impairment to the circulation, subjectively or objectively.

Paroxysmal tachycardia has been fairly frequent in my series, and, moreover, except for the annoyance of the attacks, the patients have been none the worse for it. A paroxysmal tachycardia, you will recall, is really a series of auricular premature systoles, and an auricular premature systole is a beat initiated from some point or muscle-fiber in the auricle other than the pace-maker, the sino-auricular node of Keith-Flack. It is an ectopic beat, an abrupt shifting of the pace-maker from its normal site to an abnormal one; hence, the transition must occur between beats, and the onset and offset—*i. e.*, cessation—must be abrupt between beats, in contradistinction to the gradual waxing and waning of physiologic tachycardia. The rate varies usually between 140–200.

I have 4 cases in this series—*i. e.*, 8 per cent.

A man, fifty-six years old, blood-pressure 230/120, normal renal findings, extensive pulmonary tuberculosis, had the attacks for years. I was able to teach him how to stop the attacks by pressure on his right vagus nerve as it coursed in the carotid sheath.

A second case had had his attacks since boyhood. When I first saw him he was fifty-two years old, a well-developed man of

[1] Archives of Internal Medicine, vol. ii, No. 1.

florid complexion who looked the picture of health. His blood-pressure was 180/100, his renal tests normal except that his blood uric acid was 5.3 mg. The heart was hypertrophied, showed premature systoles that the electrocardiogram demonstrated arising from the right base. He had long ago learned how to control them by a maneuver: he would sit down, draw himself together, then get up, stretch his arms widely, and the attack would stop. Patients learn one maneuver or another that stops the attack, all of which are analyzable into stimulation of the vagus, mechanical or physiologic.

Another case was a woman fifty-seven years of age. She has been under my observation for seven years. When I first saw her the blood-pressure was 230/120. It has rarely if ever been below this, often more. She is very athletic and exercises hard with impunity. She has a huge hypertrophy, a systolic murmur over the second right space, and premature systoles. She has had tachycardia for years, but singularly enough, and for what reason I do not know, the attacks have ceased in the last two years.

Auricular Fibrillation.—Janeway has said that auricular fibrillation is rare in this class of cases. I have one case, proved by an electrocardiagram, a man of fifty years of age, who when I saw him was fairly waterlogged as the result of a gross decompensation. At this time his blood-pressure was 130/80, but his physician had read his blood-pressure at 162/80, and he had an enormous hypertrophy of the left ventricle which bespoke a long-standing hypertension.

Janeway's statement I believe to be correct and, indeed, we know that the vast majority of cases of auricular fibrillation are furnished by mitral stenosis and the senile heart, under neither of which categories do the hypertrophied hearts of hypertension fall. It has frequently been noted that hypertension occurs not uncommonly among cases of *mitral stenosis*. Statements to show that these cases are associated with fibrotic kidneys and arguments to demonstrate that the nature of this association is: (1) accidental, (2) due to a same cause, (3) the fibrosed kidney is due to the mitral lesion, and (4) the

mitral lesion is due to the fibrotic kidney, have been well presented by Cowan and Fleming in the Quarterly Journal of Medicine, 1912. I have seen this association several times.

One case, in a woman thirty-nine years of age, I had under observation for ten years, saw the mitral stenosis develop, and some years after its incipiency, saw the hypertension follow. A soft apical systolic murmur was heard in 1907, a distinct murmur in 1908, a presystolic in 1911. At this time her hypertension was first noted. Her blood-pressure in 1911 was 160, later in the year 180; in 1912, 210/115; after that it ranged about 200/120. In 1914 she was pronounced by one of the ablest diagnosticians of the day a case of chronic interstitial nephritis. Urine 1024, trace to heavy trace of albumin, few casts seen in 1915. Phthalein test 26 plus 25 equals 51. Blood uric acid 1.7 mg. per 100 c.c. Non-protein nitrogen 23 mg. per 100 c.c.; later, McLane index, determined at the Rockefeller Institute in this city, 91 to 112. She is still living and has shown no symptoms of uremia in all these years.

Here is another case. Woman, forty-nine years of age. Blood-pressure 210/100 to 230/130. Noted first four years before. Heart, mitral stenosis. Had several attacks of edema of the lungs, first four years ago. Urine 1014, faint trace of albumin, few hyaline and granular casts. Phthalein 32 plus 22 equals 54. Blood uric acid 2.2 mg. per 100 c.c. Blood urea nitrogen 15.75 mg. per 100 c.c.

Here is still another with the history of a rheumatic endocarditis and with a mitral insufficiency with a blood-pressure of 185/120, but mitral insufficiency is so common in hyperpiesia due to relative insufficiency that one must accept the diagnosis of rheumatic endocarditis with reserve. Murmurs are common enough. Systolic murmurs at the apex alone occurred in 22 per cent.; at base in 28 per cent.; and at base and apex in 14 per cent.

Systolic and diastolic at base 2 per cent. Presystolic at apex 4 per cent. Murmurs of aortic origin in 44 per cent.

Murmurs at the base, in second right space, I look upon as evidence of an atheromatous aorta.

Murmurs at the apex, unless presystolic or accompanying a presystolic, as due to relative insufficiency, though one cannot exclude in a small percentage sclerotic changes in the mitral valves.

Excessive Pressures.—It is always a source of surprise to note how long and how well excessive pressure may be borne. Indeed, the more I see of hyperpiesia, the less importance I place on the reading alone. High diastolics disquiet me decidedly more than high systolics. It takes a good heart to pitch a high systolic, but a high diastolic strains an already diseased artery. I fancy that among my patients those with a large pulse pressure have done very well. It means heart force, no great arterial strain, and an efficient wave sent to the periphery.

For years I have watched one patient already cited in discussing paroxysmal tachycardia with a blood-pressure from $\frac{230\text{–}260}{120}$ and very active in all her exercise all this time. Another, a woman of fifty-three or fifty-four, I watched some half a dozen years before she developed anginal pains; her blood-pressure was rarely below $\frac{240\text{–}270}{100}$. She must have borne this pressure some years before I first observed her. Still another, a woman of sixty, blood-pressure over 300 in systole (my sphygmomanometer measured only 300) and 120 diastole. How long she had had these high pressures I do not know. Under treatment one year (fourteen months) her pressure taken then showed $\frac{270}{130}$; two months later, $\frac{250}{90}$. I lost sight of her some months later, though she was still doing well. It will be noted that all had a large pulse pressure.

Early Cases.—Allbutt says: "If we can catch hyperpiesia early and keep at work against it, it can be cured more often than not." He then adds: "When the system has taken a new set, the whole has readjusted itself to the altered conditions and the new attitude is more or less permanent." This statement is an important one, for it means that when the cardiovascular system has undergone certain structural changes, a hypertension becomes a physiologic necessity and efforts to reduce a blood-

pressure to normal are abortive or, worse yet, attended by serious injury to the organism.

To the pertinent question, How is one to know whether the condition is an early one or no? he replied by suggesting that the criterion be the response to rest and simple treatment. In the early cases the cardiac outline recedes to normal proportions and the pressure falls to normal.

The essentials of treatment are rest, physical and mental, and a regulation of diet. Our great limitation comes in the fact that these cases are "caught," as he expresses it, only accidentally, in the course of a routine examination, a life insurance examination, or examination for other causes in a presumably healthy subject; for the early cases give rise to no symptoms that lead the subject to seek medical advice.

A pressure of 140 or more in systole in a young or middle-aged man or woman, if it is persistent, and even more, a diastolic of 100 or more should be looked upon with grave suspicion, carefully investigated, and the kidney having proved innocent, be considered as an early hyperpiesia.

Here is a man of forty-five years who presents a blood-pressure of 140/100; his heart shows slight hypertrophy, his palpable arteries are thickened, the vessels of his retinæ hint at change, his urine is of a specific gravity of 1027, no albumin, and no casts. His blood uric acid is 1.4 mg., and his urea-nitrogen 21 mg. per 100 c.c. This is certainly an early case.

My best results have been in the obese with hypertension, in whom a modification of diet was awarded with results.

Unfortunately, many early cases feeling as well as they do will not submit to the period of rest demanded or rebel at dietetic restrictions, so that we see the case develop under our eyes as I have in two of the cases of this series.

Treatment.—This talk is given with the especial object of making you recognize this group as an entity, but a therapeutist may hardly be pardoned if he close a dissertation of this sort without mention of the treatment. Indeed, as a therapeutist and feeling that the end and aim of the study of medicine is the cure of disease or amelioration of the distresses of disease, most articles

on medical subjects seem to me Hamlets with Hamlet left out, because treatment receives so scant courtesy in them.

Rest in Bed.—I have mentioned the excellent results of rest in bed in cases of early hyperpiesia. I am inclined in any case to study the effects of rest in bed for a week or two and further to study the after-effects. In most cases a fall of pressure occurs to some extent, but in those cases which have "taken a new set," as Allbutt puts it, the blood-pressure goes up again when the patient is once more up and about. This variation, indeed, might be anticipated as expressive of changes in physiologic demands.

Rest in bed has a special value in those cases in whom a sudden access of hypertension, so-called hypertensive crises, have occurred, and, finally, rest in bed is imperative when premonitions of cerebral accidents are noted and when any degree of cardiac decompensation is determined. The length of time depends on amelioration of symptoms, but it must be remembered that too prolonged confinement of weeks' duration is prejudical, especially to the aged.

Diet.—Many, frankly, the majority of these patients are hearty eaters, the florid, beef-eating, English Squire type. Some are obese. Many, however, are neither florid, obese, nor hearty eaters. Allbutt thinks diet plays a considerable rôle in the causation of the condition. Work by Gettler shows that the plasma solids and the refraction indices of the plasma are much increased in this class of patients in contrast to the hypertensive cases of Bright's. Unpublished observations made in my wards would seem to corroborate these findings (laboratory work done by Dr. Gettler and assistants). One might conjecture some association between these changes and those in viscosity.

It has been my custom to make most of these patients practically vegetarians, limiting them to 48 to 56 grams of protein a day; this is easily accomplished on a vegetarian diet. Of late I have felt that complete exclusion of meat was not wise in all cases, but have tried to restrict the protein to the same extent, but allow a more varied and palatable selection.

The total intake is to be considered. The best results I have had have been in the obese who underwent a reducing diet. In

this class the close relation between the quantity of food ingested and pressure seems convincing. Here starches and sugars undoubtedly play a rôle.

When Dr. Robert Cooke was studying some phases of hypertension on my wards at Bellevue we were convinced that in some cases at least the ingestion of salt increased the blood-pressure. It is my custom to limit the salt intake to that quantity necessary in cooking to make the food palatable, asking that it be discarded as a condiment and urging the use of unsalted butter. All condiments and rich sauces and gravies are excluded.

As regards the quantity of fluids to be taken, I have advised that the patient's thirst dictate this, feeling that when salt, condiments, alcohol, and rich sugary foods are excluded the demand will not be excessive. Of course, in the presence of cardiac decompensation a marked restriction in fluids is often most beneficial. Alcoholic drinks, I think, should be interdicted, though the habits of a lifetime may in individual cases make a compromise desirable not only for the comfort but the welfare of the patient.

Bowels.—I am in no way convinced that the condition of the bowels has anything to do with hypertension, but abnormal fermentations and putrefactions undoubtedly add, through absorption of their products, burdens to the organism. For that reason I am accustomed to advise blue mass, 3 to 5 grains, once a week and some saline in not too drastic doses once a week between the mercurials, and in the chronically constipated, in addition, milder cathartics or measures such as are usually effectual in such cases.

Habits and Exercise.—A man with hypertension should be warned to make his life less strenuous, to beware taking on new enterprises that entail great mental stress, to make his holidays more frequent and a little longer, to make his business hours a little shorter; but by no means make an invalid of him. Divorcing these people from their work and their life's interest often works great harm. They go to pieces frequently with astonishing rapidity. Even when the heart begins to manifest shortcomings or minor cerebral accidents have occurred, when once the one

has been remedied as far as possible and the other has had time to repair, a return to their interests is beneficial.

For patients with hyperpiesia exercise is important. When heart and vessels seem competent I have not limited the amount or character of exercise unless it entails places in which an apoplexy might jeopardize life, as in swimming. One of my patients, a woman in the middle fifties, walks several miles each day, skates enthusiastically in winter, and plays tennis, often several sets a day, in summer. Though I have watched her for a number of years I have seen only good come from it. Most patients of the hyperpietic age choose less vigorous forms of exercise, such as walking, the best of all, and golfing. In those with cardiac limitations exercise must be adapted to the state of their circulation and the same methods followed as in other cardiac cases. Sudden exposure to cold should be avoided and clothing chosen to avoid sudden chilling of the skin. High altitude should be approached gradually, and much above 1500 feet entails a risk to heart and arteries.

Treatment of the Hyperpiesis.—Again permit me to emphasize the necessity of studying the patient with reference to his reaction to his hyperpiesis. That pressure at which he feels best and at which his functions are best subserved is his *optimum* pressure, regardless of figures, and is not with impunity interfered with. Do not interfere by the use of *dilators* unless heart or artery gives the signal. If you succeed in lowering the pressure your patient may be much worse off than before; commonly you do not succeed. When the blood-pressure has rapidly shot above its accustomed figures, a sense of unwonted fulness or headache warns of impending danger, or the heart is obviously laboring without results against a burdensome pressure, then use the dilators.

The nitrites are the choice, nitroglycerin or erythrol-tetranitrate. The former may be given in such doses as accomplish the object or provoke the unbearable headache that compels you to stop. I do not know what the toxic dose is. Give $\frac{1}{100}$, $\frac{1}{50}$, $\frac{1}{25}$, or $\frac{1}{10}$ grain every two hours if needed. If headache occurs before any fall is observed, do not use it again, try chloral, 5

grains, at four-hour intervals or four doses a day. This should be used only a few days at a time; cautiously, when the heart is weak, and stopped when drowsiness by day is marked. In those troubled with much insomnia no doubt the sleep it affords works favorably on the hyperpiesis. The iodids have a traditional usage, but I am inclined to question their efficiency. They are prone to upset the stomach. They are said to give good results in syphilitic cases, but lues does not cause hypertension.

High-frequency current is highly lauded by its advocates; even Allbutt speaks a very good word for it. He says its failure is due to too limited usage. (He quotes from Humphris.) The technic of this proceeding must be sought in articles especially devoted to the subject. I have submitted several patients to efficient hands, but have been very poorly impressed with the results. However, I have had astonishing results cited me by good observers.

Venesection has impressed me more favorably. I have taken 10 to 16 ounces of blood from patients with satisfactory results. I have not observed a sudden fall after the withdrawal, rarely more than 10 mm.; sometimes none, but many patients feel better, get a relief of the sense of fulness in the head, and seek voluntarily for further bleeding. The results are sometimes astonishingly lasting, even for several months.

I might lengthen this already much too lengthy discourse by discussing the treatment of the various conditions to which hyperpiesia leads—apoplexy, cardiac decompensation, angina pectoris, tachycardia, etc. But these must be deferred to other times and places. I hope I have convinced you that there is a distinct entity characterized by hypertension, hyperpiesis, as Allbutt prefers to call it, and to which he has given the name hyperpiesia, often mistaken for Bright's disease by physicians and pathologists, but which claims no kinship to Bright's in its symptomatology or its ultimate issue.

CONTRIBUTION BY DR. WILLIAM H. PARK

LABORATORIES OF THE NEW YORK CITY DEPARTMENT OF HEALTH

PRACTICAL IMMUNIZATION AGAINST DIPHTHERIA[1]

Discovery and Development of Artificial Immunization against Diphtheria. Experimentation, Animal and Human, and Results. Extent of Natural Immunity. Valuable Aid in Schick Test. Description of this Reaction and its Uses, Experimental and Practical; Confusion Caused by Association of Protein Sensitization and Method of Differentiation: Necessity of Accuracy and Standardization. Assurance of Practical Immunity against Diphtheria in Man. Absolute Harmlessness of Injections. Time of Development of Immunity. Duration of Immunity. The Toxin-antitoxin and Its Practical Application. Selection of Cases for Immunization. Results in Five Representative Institutions.

THE first idea of the immunizing power of the diphtheria toxin modified by the antitoxin came accidentally through the fact that a number of the guinea-pigs used to test the potency of diphtheria antitoxin survived. This potency test is carried out by mixing certain quantities of the horse-serum of unknown antitoxic strength with a number of fatal doses of diphtheria toxin. In carrying out the test a certain proportion of the animals usually receive a mixture which overneutralizes and, therefore, is not poisonous. Some of these guinea-pigs kept for a number of months were again used for antitoxin potency tests, and it was found that although they had not been poisoned by the toxin-antitoxin mixture, they nevertheless had developed im-

[1] Lecture addressed to the monthly class of Military Surgeons at the New York University and Bellevue Hospital Medical College, May 13, 1918.

munity through the stimulus of the toxin in the slightly over-neturalized mixture.

The first use made of this knowledge was in the rapid immunization of horses. It was found that by giving a mixture of toxin and antitoxin the first injection of toxin could be very much larger than if the pure toxin were given. It was also found that if haste were required in producing potent antitoxin, large amounts of this apparently neutral mixture could safely be given at short intervals, and the horses would produce potent serum within a few weeks. Thus, in 1905, I reported that horses had produced as high as 400 units per cubic centimeter after six injections of this antitoxin mixture.

Soon after these successful experiments the possibility of immunizing human beings susceptible to diphtheria occurred independently to several laboratory men. The first to suggest it in writing was Theobald Smith. A number of difficulties, however, made this at the time impracticable. The fact that animals received these injections without any poisonous effects seemed to guarantee that human beings would also find the mixture harmless. There was a certain hesitancy, however, in accepting the animal experiments as full proof that these injections would not be deleterious to man. The most serious objection was the fact that we knew from careful testing of human blood in guinea-pigs that some 50 per cent. of children and some 80 per cent. of adults were already immune to diphtheria. This knowledge regarding any person could only be obtained by actually taking blood from the individuals to be immunized, and the only way that successful results from the injections could be estimated would be to take and test additional bleedings from time to time. The time and annoyance consumed in these investigations of each individual case almost prevented any thought of a general use of the immunizing mixture. It had been found meanwhile that in animals which possessed no natural antitoxin, toxin injections were followed by a very slow immunizing response. For instance, 12 guinea-pigs were given by me a full size injection. At the end of four weeks only 2 had become immune; at the end of eight weeks 8 had become immune; and at the end of twelve weeks the

11 surviving had all become immune, the twelfth guinea-pig having died of an accidental infection due to other causes. The response was entirely different in those having natural antitoxin.

In a series of 10 horses, 9 of which had traces of antitoxin in their blood, a marked immunizing response developed within twelve days; from 0.1 to 1 unit per cubic centimeter of antitoxin present before the injection, there developed from 3 to 5 units per cubic centimeter in different animals, while in one horse that had no antitoxin no appreciable response took place before four weeks. It was, therefore, fair to assume that in human beings the same results would take place; that is, those who were immune through antitoxin would develop very quickly additional antitoxin, while those possessing no antitoxin would have a delayed but nevertheless final antitoxin production.

A test was developed meanwhile which enabled us with the greatest ease to determine whether antitoxin was present or absent in any individual. This is now familiar to all as the Schick test. The development of this was interesting. In order to save guinea-pigs it had become the custom to inject intracutaneously small amounts of the toxin-antitoxin mixture which had been made to test the potency of the different lots of serum. It had been found that a roughly accurate estimate could be made by observing whether the injection was followed by inflammatory reaction in the skin or not. The degree of the reaction also gave an indication as to the excess of the toxin in the mixture. It occurred to Schick that if a definite quantity of toxin were injected intracutaneously in individuals to be tested, this small amount of toxin would, in the absence of any antitoxin in the skin fluid, cause a little inflammatory reaction shown by hyperemia and slight swelling. After a number of tests he found that 0.02 of a minimum fatal dose for a 250-gram guinea-pig was an amount which, in the absence of antitoxin, would cause in from twenty-four to forty-eight hours a marked hyperemia of the skin, with an area the size of a 25-cent piece. This was accompanied with some infiltration and later slight desquamation. A brown pigmentation usually remained from a week to over a month. He

found that if sufficient antitoxin was present in the body to insure immunity there would be no response to the toxin, as it would be neutralized by the antitoxin in the skin fluid. Faint traces of antitoxin would lessen the intensity of the Schick reaction. If desired, a rough estimate of the amount of antitoxin could be determined by giving slightly larger amounts of toxin. This, however, was only used for experimental purposes.

Schick soon noticed that in the older children and adults a considerable percentage showed a protein reaction which had nothing to do with the toxin. In these cases, even when the mixture was overneutralized with antitoxin, this same pseudo-reaction developed. In most cases this reaction came on more promptly, covered a larger surface, was more of the urticarial type, and disappeared within three days. In a small percentage, however, it was very difficult to decide between a true and a pseudoreaction, and especially when a true reaction was combined with a pseudoreaction to decide how much was due to the toxin and how much to the non-toxic protein, because the fact of the development of a true reaction in no way prevented the protein reaction.

The best practice, therefore, in adults is to inject the toxin in the skin of one arm and the heated or neutralized toxin in the other arm. In this way the amount of protein reaction can be noted and it can be decided whether the reaction following the toxin is a simple, true reaction, a pseudoreaction, or a combined reaction. Even after the eye has been thoroughly trained, it is still wise to use the two injections when possible. On other occasions only one injection is made, and any cases which remain in doubt are retested or considered as true reactions.

I think it is apparent to all that the Schick reaction, although a very simple test, must be carried out with the greatest accuracy or the results will be entirely misleading. If the toxin has been diluted and stored it may readily deteriorate, and instead of giving 0.02 of a fatal dose, only one-half that amount may be injected and no toxic reaction will occur, and the misleading idea is given that the person has been shown to be immune. If the toxin is carelessly diluted and a large surplus of toxin is given, slight

necrosis may develop at the point of injection. Twice in New York State this accident has occurred and some hundreds of people developed very sore arms. The neutralized or heated toxin used for the pseudoreaction must equally be carefully prepared. If possible the altered toxin used in the control test should be from the same preparation as the toxin used, so that the non-toxic protein will be similar in amount and kind, otherwise no comparable response can be depended upon. Recently, at one of the large concentration camps, I believe insufficient care was used in preparing suitable toxin and protein solutions, so that in comparing the two injections they falsely assumed that the difference was always a true Schick reaction, and in this way obtained the remarkable result that some 60 per cent. of the troops were susceptible to diphtheria, and that the individuals that showed positive or negative Schick reactions changed from month to month. These results, which are contrary to those obtained by all other trained observers, would be readily explained by the simple fact that they used injections of materials improperly standardized.

The first attempt to use the injections in man was in 1913, when von Behring actually tested the practical value of over-neutralized toxin injections in children and adults, and after a few weeks' experimentation made a very optimistic report in which he stated that within two weeks over 60 per cent. became immune. A study of his figures revealed the fact that he had not tested the individuals before immunization as to whether they already had antitoxin or not, and this undoubtedly led to his erroneous opinion of early favorable results. Von Behring's first immunizations, although misleading in their results, furnished the world with the evidence that the injections were harmless, and they stimulated a number of us to investigate in a more accurate way the value of the attempt at active immunization. The important facts to be determined were: (1) The amount of toxin and number of the injections and then the harmlessness when used at all ages; (2) the response in the way of immunization, and (3) the persistence of the immunization if it occurred.

In New York Dr. Zingher and I, and later others of our co-

workers in the Health Department Laboratory, began by testing through the Schick reaction the children in our contagious disease hospitals. Those who gave positive reactions were given the injections. Schick tests were done from time to time, and we followed the responses not only while the children were in the hospitals but also for months after they had returned to their homes. The results showed themselves to be so very favorable that some fifteen institutions, in which large numbers of children were gathered and where they remained for a number of months or years, were also taken into the investigations. For the last three years we have had these institutions under observation. We also were able to test, immunize, and keep under constant observation the infants and children at the Home for Hebrew Infants in which the attending physician, Dr. Alfred Hess, and the pathologist, Dr. Julius Blum, are both connected with the Department of Health Laboratory. Later, army camps and additional institutions in which infants and older children were cared for were added to those in which the immunizations were first carried out.

Although only three years have elapsed since considerable numbers have been immunized, the results are so favorable that the practical immunization of the child and adult is assured. The response in young infants who are at the time passively immune through transfer of antitoxin from the mothers is still under investigation.

We will now take up in detail a few of the more important phases.

Harmlessness of the Injections.—Animal experimentation showed that in them an amount of antitoxin sufficient to neutralize the poisonous action of the toxin could be added without interfering with the production of antitoxin. It was found that the best results were obtained with a toxin just sufficiently neutralized to prevent its poisonous effect. With this knowledge, the first immunities in human beings were brought about in adults, and then, as experiments showed that no harmful results developed, children and, finally, infants were immunized. During the past few months careful observations have been carried out in a

number of infants in institutions. Many as young as four days have been injected. Careful observations are made of temperature changes, weight, appetite, the effect on the blood, and changes, if any, in the urine. Except in an occasional infant in whom a slight rise in temperature occurs, no other changes have been noted; even the pseudoreactions which occur in older children and adults are absent in the infants, and in only about 10 per cent. is there even a slight redness at the point of injection. It seems, therefore, that these injections can be considered as absolutely harmless. It is necessary to emphasize that the toxin broth employed should be carefully prepared so that no other bacterial poisons than those of the diphtheria bacillus be present, and that the neutralization by the antitoxin should be thoroughly controlled by animal tests before it is used in the infant or child.

In possibly 20 per cent. of older children and adults the pseudoreactions may at times be fairly marked, so that considerable local and some slight constitutional disturbance may be noted. These are less severe than in typhoid vaccine inoculations. Contrasted with the use of vaccine virus to prevent smallpox the reaction is much less; in the latter we are using a living virus and must expect the development of a local ulceration and of considerable constitutional disturbance, and there is always the possibility of infection. None of these conditions can possibly develop with the diphtheria toxin-antitoxin injections.

The Time of Development of Immunity.—The observation of a large number of individuals showed that, as in animals, no appreciable immunity takes place in any who have no antitoxin at the time of injection until two weeks have elapsed. This prevents the use of active immunization to stop quickly an outbreak of diphtheria in a camp or an institution. At about the fourteenth day a small percentage show sufficient immunity to give a negative Schick reaction. Week by week the percentage of immunes increases, until by the eighth week about 80 per cent. are immune, and by the twelfth week 96 per cent. By the end of four months the full percentage has developed, which is about 98 per cent. The remaining 2 per cent. if re-injected have, so far as we have observed, always become immune.

It has been found that three injections give a somewhat higher percentage of development of immune persons and a somewhat greater accumulation of antitoxin than two injections, and that two injections give decidedly better protection than one injection. It may readily be that by increasing the amount of the injections a single treatment may give sufficient immunity. At the present time we are trying by increasing the doses to reduce the three injections to two or one. Up to the present, however, the three-injection method is the standard one to be adopted. The larger amounts for the one- or two-injection methods are still in the stage of experimentation.

The Duration of the Immunity.—We have now had under observation something over 1000 infants and children who were susceptible and became immune through the antitoxin injections. These have been tested at the end of a year and at the end of two years, and some at the end of two and a half years. At the present time only 2 per cent. of those who became immune have apparently relapsed and become susceptible. It seems, therefore, as if a person becoming actively immunized develops a condition similar to those who are naturally immune, that is, the stimulus to produce antitoxin given by the toxin-antitoxin injections has started the cells to produce without reference to any further stimulus of the toxin. This joins these persons to the 80 per cent. of the population who naturally develop antitoxin. At any rate, we are sure that up to two and a half years only 2 per cent. have lost their immunity. Each additional year will give us further proof as to whether this immunity, like natural immunity, is persistent for the duration of life.

While we have been observing the children who have been immunized we have also been following up the greater number which showed a negative Schick reaction. Those who have passed the age of four when tested have continued to show a negative reaction. An interesting series of observations on very young infants revealed the following: Schick tests were made shortly after birth and then at intervals of three months on a series of infants. A number have now reached the age of four years. We found that during the first year of life, of 88 infants

that were negative to the Schick test, 13 changed to a positive reaction; during the second year of life, of 75 negative to Schick, 10 changed to a positive reaction; during the third year of life, of 61 negative to Schick, 3 changed to a positive reaction. Undoubtedly many changed to a positive reation and then back to a negative one between the tests, the passive immunity giving way to an active one. These changes in early life are due to the fact that the infants inherit passive antitoxic immunity from their mothers. This disappears usually some time after the first six months and within the first two years, but in a few it persists during the third year. When frequent tests are made we have found that the great majority of infants at some time become positive to the Schick test, and then, as they grow older, 80 per cent. of them become immune. This takes place usually during the first four years, but a small number develop immunity up to the tenth year or even later. The fact that a person who has once developed immunity, either through natural causes or through immunization, holds this condition probably throughout life makes a Schick test of extreme value because both the persons who have become immune and those who have charge of them are reassured when in the presence of diphtheria. A woman who has a negative Schick test has the comforting knowledge that her offspring will certainly be immune during the period of infancy.

The Toxin-antitoxin and Its Practical Application.—The material injected consists of diphtheria toxin made in the usual way for the injection of horses, except that somewhat greater precautions are taken in the preparation of the meat broth before the inoculation with the diphtheria bacillus. Before use this toxin is ripened by allowing it to stand at a moderate temperature until the first changes in toxicity have ceased. This toxin, which is now quite stable, is then tested for its potency, and is so diluted that 1 c.c. will contain about 200 fatal doses for a guinea-pig. This is then slightly overneutralized with antitoxin. The most effective mixture is the one which when given in a very large dose to a guinea-pig will cause either no symptoms or very slight paralysis. This has been found to be an absolutely safe mixture

and one that will produce the greatest amount of immunity in a human being. This preparation is kept in the ordinary vials at a temperature not exceeding 70° F., and is good for at least a year. It can be obtained from the Department of Health of New York City and from the larger manufacturers of bacteriologic products. The injections should be made subcutaneously, the most convenient place being usually the left arm. Any portion of the body, however, gives equally good immunizing results.

At the present time I usually give three injections at weekly intervals. Under certain conditions, where there is no immediate probability of infection, a single injection is given, and at the end of three months a Schick test done. About 60 or 70 per cent. will be found to have been immunized and only the remainder will need an additional two injections. It is, however, often so difficult to be sure of being able to get hold of persons at a later period that the usual three-injection method is the most advisable. As I stated earlier in this lecture, further experimentation may perfect the method so that a single large dose may suffice.

In the thousands of injections carried out there have not been any serious deleterious after-effects. With the early preparation, three children developed some immediate symptoms of protein poisoning, but they all recovered completely within forty-eight hours. These symptoms were probably due to the fact that the broth for the toxin was made in the old way, in which the meat was allowed to ferment in the incubator in the preparation of the broth before inoculation of the diphtheria bacilli. This is a suitable method for preparing toxin for injection into the horse, but is not suitable for use in man.

Selection of Cases for Immunization.—Vital statistics teach us that the greatest mortality from diphtheria is in the second year of life. The infant at birth, possessing immunity transferred to it by its mother, by the end of six months may have lost this protection, and sickness and death from diphtheria rapidly increase during the second six months. At the end of the second year a number of susceptible children begin to develop natural immunity and, in addition, their great strength enables them to withstand the disease, so that the number of deaths which are

highest in the second year of life gradually lessen from then on. Older children and adults, although they may develop a considerable amount of diphtheria, seldom die from the attacks, especially since antitoxin has been in use.

With these facts before us it is easy to realize that when we consider the population as a whole, the most effective period in which to apply immunity is during the first six months of life. Fortunately, the fact that infants receive the injections with so little disturbance makes this probably the best period of life to receive them. The above observation applies to the population as a whole.

It will undoubtedly be many years, even if our hopes as to the permanent persistence of active immunization are fully realized, before this method of treatment will be in general use. It is important for us, therefore, to consider under what conditions immunization should be carried out. In institutions where children are gathered together immunization is of great value. At the Home for Hebrew Infants the active immunization of all children showing a positive Schick reaction has prevented the development of any case of diphtheria for three years, although before these injections were used there had been yearly epidemics with the accompanying loss of several lives. The fact that there were during the first two of the three years a number of carriers of diphtheria bacilli among the youngest children adds to the proof that the prevention of diphtheria has been due to the immunizing injections. The practice has been to do a Schick test every three months and to only immunize the infants after they lost the immunity acquired from their mothers. This, probably, is the best practice for institutions where a bacteriologist is constantly on duty. Otherwise, it may be more sensible to inject all of the infants so as not to be liable to outbreaks occurring in those who have lost their immunity.

At the present time active immunization is being practised quite largely in the United States Navy and, to a considerable extent, in the Army. Although with antitoxin available death in an adult from diphtheria is rare and should never occur, nevertheless, under the conditions in military service the presence of a

few cases of diphtheria, with usually a number of diphtheria carriers on a vessel or in a concentration camp, creates a difficult situation to handle. By Schick-testing the men and giving the immunizing injections to those who react positively protection can be granted, and diphtheria made to cease as either a menace or an annoyance.

It should be noted that the development of immunity, either from natural means or through injections of toxin-antitoxin, or through injections of antitoxin, in no way prevents a person becoming a carrier, and that a carrier can, as any other individual, develop an ordinary follicular or croupous tonsillitis or pharyngitis. A case, therefore, that has a negative Schick reaction—*i. e.*, a person who possesses antitoxin and develops a suspicious throat, and a culture shows diphtheria bacilli—is no more a case of diphtheria than a person developing similar lesions who has no diphtheria bacilli. In one case we have an infection in a person who is a carrier of the bacilli, and in the other a person who is not. We are so apt to think that a positive culture in a suspicious throat proves that the lesions are due to the diphtheria bacilli lodged thereon that we forget that a carrier is just as apt to be infected with pyogenic organisms as one who is not. Frequently in scarlet fever patients in our hospitals croupous tonsillitis develops. Among these are some who have been immunized with antitoxin and others who are naturally immune, as shown by the Schick test. In all of these we realize that the individuals have antitoxin, and we find that without injections they recover just as well as with injections. We have never had a person with a negative Schick reaction develop the characteristic symptoms of diphtheria. It is certainly impossible for any person with antitoxin to be constitutionally poisoned by diphtheria toxin. Observations indicate that not even the superficial epithelium in these immune persons is poisoned by the diphtheria toxin made by the bacilli in carriers. It is absolutely proved that this does not occur to an extent which is characteristic of diphtheria. While a negative Schick test demonstrates that a person is safe, a positive reaction does not prove one is necessarily at the time susceptible, as there is, as in other infections, bactericidal immunity. The

recovery in most cases of diphtheria is due to the development of bactericidal and not antitoxic immunity.

RESULTS IN FIVE REPRESENTATIVE INSTITUTIONS

Institution.	Number of susceptible children given toxin-antitoxin injections remaining under observation.	Period of observation. Months.	Percentage remaining immunized.
1	84	24	97
2	74	22	97
3	106	24	97
4	42	22	92
5	150	13	95

The results obtained are given so that the actual development of an immunity following either two or three injections can be seen. In all the other ten institutions similar results were obtained. Others added later will only become of importance when sufficient time has elapsed to test the persistence of the immunity.

CLINIC OF DR. FREDERICK TILNEY

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WILSON'S DISEASE—PROGRESSIVE LENTICULAR DEGENERATION [1]

Essential Pathologic Findings. Historic Points; Work of Samuel Alexander Kinnear Wilson. Case Report: Personal and Family History; Onset of Illness, with Symptoms; Physical Examination; Laboratory Tests; Development of Symptoms; Death. Discussion of Differential Diagnosis. Postmortem Findings. Prognosis in Wilson's Disease.

THE subject of today's lecture is progressive lenticular degeneration, a pathologic condition of the brain known as Wilson's disease, in consequence of the brilliant investigations published by that English writer in 1912. From the pathologic standpoint Wilson's disease is characterized by a remarkable coincidence of morbid changes in the liver and corpus striatum. The explanation of this simultaneous hepatic and cerebral involvement is still being sought, while the symptom complex, arising apparently as a direct result of the alteration in the lenticular nucleus, has stimulated a renewed interest concerning the nature and function of the corpus striatum, that part of the end-brain which continues to invite the interest of the investigator as much as it perplexes the clinician.

Historically, it is interesting to note that the syndrome had been recognized as such long before the significance of the malady was suspected. As early as 1854 Frerichs gave the first exact description of Wilson's disease as we know it today in a treatise

[1] Lecture delivered to the Fourth Year Class of the College of Physicians and Surgeons, New York, May, 1918.

on diseases of the liver. Frerichs' case was a boy ten years of age who developed at this time of life dysarthria, dysphagia, weakness of the limbs and tremors, while later on he became greatly emaciated and manifested a striking slowness in all of his movements without, however, the presence of any paralysis in the strict sense. In addition to these motor changes the patient showed a marked loss of facial expression. At no time during the course of the disease was there any involvement of sensibility and no evidence was elicited showing disease of the liver. Upon autopsy, however, an extreme hepatic cirrhosis was found which was reported as the sole pathologic finding in this case. Clearly, then, Frerichs had recognized most of the clinical symptoms which go to make up the syndrome of Wilson's disease. Moreover, he discerned one of the essential features in the pathology, namely, the hepatic cirrhosis. What he failed to observe, however, was the condition of the corpus striatum.

Many years passed before a similar case appeared in the literature, for it was not until 1888 that Gowers published a complete description of all the symptoms observed in progressive lenticular degeneration, calling the condition *tetanoid chorea.* He also made note of the changes in the liver, but it was not until several years later that he was struck by the fact that these hepatic changes were associated with what appeared to be a disease of the extrapyramidal system. A short time after the publication of this case a sister of this same patient came under Gowers' observation suffering from identical symptoms. This gave color to the supposition that the disease was probably familial and possibly hereditary.

It remained for Wilson to collect from the literature some 12 cases and, from personal observations of his own, to show that there is a disease pathologically characterized by the simultaneous involvement of the corpus striatum and the liver, occurring in childhood or adolescence, having a familial tendency and consisting of the fairly well stereotyped group of symptoms which distinguish it.

The patient whose history is here presented is one of the

few cases upon which there has been opportunity to make extensive study in this country. He was a Scotch boy, fifteen years of age, and was admitted to the Presbyterian Hospital because he suffered from a stiffness and trembling of the right arm, together with difficulty in speaking. Whenever the patient attempted to use his right arm for any purpose the hand trembled so that it was almost impossible for him to perform any skilled act.

This boy came to the United States when he was four years old, since which time he lived in New York City. Until his present illness he was considered a healthy and a normal boy. His school career was good. He was considered bright and graduated from grammar school at eleven years of age. His previous history shows little of moment. He had measles and scarlet fever when he was eight years old, but made a good recovery from both these illnesses. When he was ten years old he was operated on for the removal of tonsils and adenoids because of some respiratory disturbance, and thereafter was not subject to sore throat or any sort of sickness. He had no bad habits and his general physiologic status was good; he slept and ate well, his bowels were regular, and his weight was normal.

The family history of this patient should be scrutinized with more than usual care, knowing as we do the familial and perhaps hereditary tendency of this disease. The boy had two brothers and a sister younger than himself. All of them, up to the time of his death, were in good health and have remained so to the present time. There is no history of any similar illness in the family of either parent, nor, indeed, is there any record or recognition of family nervousness or neuropathic tendency. There is no history of syphilis, deafness, blindness, alcoholism, or feeble-mindedness in the direct or collateral branches of the patient's family.

The first indication of the illness which ultimately caused the patient's death made its appearance in August, 1912, when he began to notice a change in his control of his right hand. There was apparently no cause for this at the time. He complained that his fingers and forearm shook when he tried to write or to

button his clothes. This shaking was not confined to the right hand, for when he was excited or fatigued both hands trembled and the arms grew stiff. He was sent to Canada in December, 1912, in the hope that a change of climate would improve his condition, but during the nine months of his sojourn there no perceptible change could be noted. In fact, he seemed to grow progressively worse.

Upon admission to the Presbyterian Hospital in August, 1913, the stiffness had extended from the arms to his entire trunk musculature as well as to his legs. There is some evidence that he may have had a slight convulsive seizure before entering the hospital, but, as this occurred at night and as no similar attack was observed during the course of the disease, it is open to question whether the boy suffered an actual convulsion.

Another striking feature at this time was the boy's facial expression. The muscles of his face had become stiff, so that his mouth gaped widely most of the time, giving him a stupid appearance. At intervals he would give voice to a sound not unlike the cry of an animal. This was high pitched and explosive in character. It did not denote any emotional change in the patient, nor was he cognizant of any provocation.

Neurologic examination made at the time of his entrance to the hospital was as follows:

Co-ordination showed no marked disturbance either equilibratory or non-equilibratory. Later, when the muscles became rigid, it was difficult to estimate the state of his co-ordination.

Skilled acts showed no adiadokocinesis or dyssynergia. There was no apraxia, dyspraxia, or aphasia. The patient could move either arm at will, and oftentimes with much force. There was no demonstrable paralysis. Pronunciation became progressively more difficult until finally a well-marked dysarthria was present.

All of the deep reflexes were equal and active on the two sides. There were no pathologic reflexes present. The superficial reflexes were present and active on the two sides. There was no Babinski, Chaddock, Oppenheim, or Gordon.

Aside from the questionable convulsion previously referred

to, the only other abnormal involuntary movement present was the tremor, which has also been referred to. This was most marked in the hands, but could be observed in the forearms and arms, as well as in the tongue. Its rate was 5 : 6 per second, it was rhythmic and of relatively small amplitude. Action and emotional influences increased it, but it disappeared during sleep.

The muscular strength at the time of entering the hospital was full, but subsequently it decreased rapidly. There was no change in the volume of the muscles nor in the contour of the parts. The entire somatic musculature seemed denser because of the rigidity. The electric reaction was normal. The myotatic irritability showed some increase, but the nerve status was normal.

The general sensory examination showed that all qualities of sensibility were normal.

All of the cranial nerves were normal with the exception of the facial, glossopharyngeal, and vagus. The facial muscles were rigid and gave the mouth a gaping appearance. There was considerable dysphonia and a progressive dysphagia.

The laboratory tests of the blood, spinal fluid, urine, and feces were negative. The carbohydrate assimilation test showed nothing abnormal.

In the first days of the patient's stay in the hospital he was able to walk about with assistance, but his arms and legs were held in the rigid attitudes shown in Fig. 1. In attempting to walk, the stiffness of his calf muscles caused him to stand upon his toes. This gave him a digitigrade progression. The muscular rigidity was present in any posture which he might assume. In sitting down the feet were held rigidly flexed upon the legs, the legs upon the thighs, and the thighs upon the pelvis (Fig. 2). The arms were also held in contracture-like attitudes, the left one being rotated internally, with the forearm extended on the arm, while the left was flexed upon the forearm, and the fingers, more especially the index and thumb, were in flexion at their proximal joints. The right arm was rotated internally and abducted slightly, the forearm was flexed

upon the arm, and the fingers and wrist resembled in their contractural postures the malattitudes of the right side.

The slightest force applied to his body would cause him to fall backward, and in doing so it seemed as though his whole body moved as a single piece. When recumbent (Fig. 3) he

Fig. 1.—Showing malattitudes in standing.

Fig. 2.—Body held rigid in sitting posture.

chose to lie upon one side or the other, with the legs and thighs in flexion.

It will be remembered that the patient gave as his first complaint a stiff shaking of the right arm and hand, and this early symptom soon became one of the conspicuous features of the disease. The tremor had many characteristics which allied it to the tremor of paralysis agitans. It was manifest in the

small muscles of the hand and in the forearm and arm. In its type and form it was monomorphous; that is to say, it always had the same rhythm and general character, although its amplitude increased during motion of the arm. At such times also there was a distinct increase in the force of the tremor. It is to be noted that this tremor, so like that of paralysis agitans in many of its features, differed in this one fundamental respect, namely, that it was increased by action and decreased by rest; and, furthermore, emotional disturbance of any kind served to make the amplitude of this tremor greater.

Fig. 3.—Attitude assumed when recumbent.

One remarkable factor about this change in the muscular system of the patient was the surprising absence of any true paralysis. The voluntary control of the muscles, although it was difficult, was nevertheless preserved. The patient could move his arms and legs at will, but each of his efforts gave the impression of a volitional exertion struggling against the resistance of his muscular rigidity.

At the end of several weeks the patient began to experience difficulty in swallowing and his speech became more difficult to understand. The increased rigidity of the muscles about his lips made his mouth gape still more widely, causing him to

have an almost idiotic expression; yet when questioned he quickly showed that his intellectual faculties remained keen, his mind alert and oriented in all respects. Indeed, far from being depressed by his distressing condition, he retained a certain sense of humor up to the time that the toxic effects of his disease caused his mind to wander. His appetite was good, his bowels regular, he had no biliary pigmentation of the skin or mucosa. His temperature ranged from 98.6° to 98.4° F.; his pulse was 110. With slight fluctuations he continued in this condition until December, 1913, when his temperature rose to 102° F. In the following week he emaciated rapidly, had profuse sweats, and gave all the evidence of a profound toxemia. On January 4th, about fifteen months from the onset of his disease, he died of a complicating pneumonia.

Here, then, is a case whose clinical manifestations align it definitely as a nervous disease. The absence of any evidence pointing to involvement of the liver, of the heart and of the blood-vessels, of the kidney and of the spleen, and even of the lungs, except in the terminal phase, shows clearly that it was not to be considered primarily as an affection of any of the visceral system. The striking combination of symptoms which it does present, however, suggests certain possibilities in the differential diagnosis. What should unquestionably be considered first in all neurologic cases is the possibility of the disease being a purely functional one. Indeed, the diagnosis made in the first instance upon this patient was hysteria. Let us stop to consider for a moment if there are grounds which would furnish justification for such a conclusion. Apparently the reasons for considering hysteria were the tremor, the muscle rigidity, the defective motion, the apparent instability of emotive expression, together with the normal reflexes and sensibility. But while these might seem to resemble hysteria, further study showed that there were certain features about the symptoms themselves which formed the strongest possible argument against such a diagnosis. These might be formulated as follows: (1) The tremor began as a slight shaking of one hand, and slowly progressed, without any known cause, until it had become very

prominent and involved both upper and lower extremities. Hysteria seldom if ever follows this method of evolution in the development of somatic motor disturbances. Usually the motor disturbance, whatever its form, is the epitome of some crisis or episode in the patient's life, developing, therefore, in connection with some definitely demonstrable cause, or at least in connection with some cause which may be revealed. Moreover, the motor disorder generally manifests itself not as a progressively increasing defect, but as a disturbance having its severest intensity at its inception. (2) The constant character, together with the insidious progress of the motor disturbance, constitute another strong argument against a possible hysteric basis for this trouble. In hysteria, while the motor disturbances may be more or less stereotyped, they have in them that protean characteristic which can scarcely escape detection. The tremor, for example, varies in its form and its amplitude, and also in the conditions under which it makes its appearance. The rigidity tends to shift from one part to another rather than to extend slowly until the whole somatic musculature is involved. (3) A consideration against the diagnosis of hysteria in this case is the history of the patient, since nothing in the record obtained from his relatives points to any hysteric episode or hysteric tendency which would incline one to the belief that the boy had a psychoneurotic make-up. (4) The course of the disease speaks even more strongly against the possibility of hysteria, for, in addition to the gradual increase in severity and extension of the motor symptoms, there appeared evidences of disturbance in the vegetative system, emaciation became prominent, the pulse and temperature began to rise, while a profuse diaphoresis was another indication of the profound toxemia from which the patient suffered.

Eliminating this possibility, we may next discuss the organic affections which this disorder simulates. Of the several organic diseases of the nervous system which might be considered are multiple sclerosis, paralysis agitans, pseudobulbar palsy, and pseudosclerosis.

Considering *multiple sclerosis* first, the age of the patient

would seem to be an argument against this disease. While there is authentic record that multiple sclerosis may begin in childhood, nevertheless such cases are extremely rare. This diagnosis, therefore, deserves attention only if the symptom complex itself is sufficiently convincing to dispel doubt. But that is not the case with this boy, for here we have few if any of the well-recognized symptoms of the disease. Unquestionably, the spasticity, the rigidity of the muscles, might well enough be the result of multiple sclerotic changes; on the other hand, not a single one of the classical triad of Charcot is present. There is, for example, no nystagmus, no scanning speech, and certainly the tremor was not of the intention type, since it was present both in action and inaction. Furthermore, to substantiate the diagnosis of multiple sclerosis, the degree of rigidity of the muscles presented by this patient should have been accompanied by some pronounced change in the deep and superficial reflexes, but such changes were absent. There was no Babinski and no conspicuous increase in the tendon reflexes. The abdominal reflexes were present. Investigation of the fundus shows an absence of the bilateral temporal pallor which has come to be regarded as such a significant feature in multiple sclerosis. Thus, the age of the patient is not alone against this diagnosis, but there is nothing in the symptom complex which would seem to uphold such a conclusion.

Considering *paralysis agitans*, certain features about this boy's condition certainly suggest this possibility, although complete analysis shows this diagnosis is untenable. In the first place, the age of the patient presents a difficulty, since we are accustomed to associate the Parkinsonian syndrome with adult life. This, however, need not prove an insurmountable obstacle to the diagnosis, particularly as the recent work of J. Ramsay Hunt has called attention to a juvenile form of paralysis agitans which he attributes to an abiotrophic disorder affecting the globus pallidus of the lenticular nucleus. But we must also take into account the type of motor defect exhibited by this patient, particularly the tremor. While it has much in common with that of Parkinson's disease, there are, neverthe-

less, features about it which cannot fail to mark it as strikingly different. Thus, the tremor is one of inaction, but its range and force and amplitude are alike increased by action and emotion. This is totally different from the tremor of paralysis agitans, which tends to subside, if not disappear altogether, during action. Again, the rigidity of the muscles has something in common with paralysis agitans, but there is a difference, not only quantitative but qualitative. In Parkinson's disease there is little tendency toward the production of malposition in the extremities, whereas in Wilson's disease the rigidity of the muscles is so great as to produce marked malposition in the fingers, hands, and arms, and in the feet and legs. The characteristic tendency of Parkinson's disease to produce certain well-defined changes in facial expression and in bodily attitude are absent in Wilson's disease, in which, though it may undergo marked alteration, the facial expression has none of the wax-mask character so common in Parkinson's disease in which the stolid and inflexible expression is quite different from the almost idiotic one seen in progressive lenticular degeneration because of the more or less widely gaping mouth.

In regard to *pseudobulbar palsy*, particularly of the bulbar type, some features of this case may be considered to warrant this diagnosis. One of these features is the emotional instability, and particularly the sharp cry which the patient occasionally uttered. Others are the dysarthria and the dysphagia which he manifested. But it will be remembered that there was no actual paralysis in the muscles of phonation nor in those of deglutition, so that the difficulty in articulation and in swallowing could not, in the strict sense, be attributed to a supranuclear lesion. The explanation of these disturbances is rather to be found in the hypertonicity of the muscles, one of the outstanding features of Wilson's disease. Therefore, to regard this clinical picture as due to pseudobulbar palsy would at once imply certain contradictions in our fundamental conceptions of the nervous system, for it would be necessary to attribute the hypertonicity, in this light, to an affection of the pyramidal tracts. It is impossible to suggest such an involvement in the

absence of the almost invariable pyramidal tract symptoms, such, for instance, as the Babinski reflex, increased tendon reflexes, ankle-clonus, and abolition of the abdominal reflexes. This possibility, therefore, is too remote to receive more than cursory attention.

In regard to the *pseudosclerosis*, certain features would eliminate this possibility. One characteristic of this involvement of the nervous system makes itself apparent in a yellow tinging of the sclera, and the absence of such pigmentation in our case is a significant argument against this diagnosis. This argument becomes conclusive through the fact that in the pseudosclerosis mental symptoms of a more or less severe grade, even to the extent of actual dementia, are present. It was notable, in our case, that the boy's mind remained normal until a few days before his death.

I think there can be no doubt, after reviewing these several possibilities in the differential diagnosis, that it would be difficult to arrive at any conclusion other than the diagnosis offered in explanation of this unusual and extremely interesting clinical condition.

In order to put the matter to the final test, we are fortunate in having the pathologic material obtained from a complete autopsy, and since then carefully studied. As has already been stated, it was impossible to make the definite diagnosis of Wilson's disease without postmortem findings, for the *sine qua non* of this diagnosis is a hypertrophy of the liver. In this case, macroscopically, the liver showed a marked cirrhosis, illustration of which is shown in Fig. 4, and the microscopic sections revealed the following: Varying amounts of edematous connective tissue, in which there are small wandering cells, fill the portal spaces. There are great numbers of regenerating bile-ducts and many capillaries. At the periphery of the lobule new forming bile-ducts are seen and they are also to be found penetrating the lobes. There are narrow bands of connective tissue between most lobules, and masses of connective tissue entirely surround an occasional remnant of a lobule, though most of the lobules are not reduced in size. There is, however,

the greatest difference in their appearance. In the greater number a cloudy swelling marks the liver cells, blue granules are found in the cytoplasm, and the nuclei, though not enlarged, stain deeply. In other lobules there is a moderate amount of fatty infiltration, particularly at the periphery. The cytoplasm is swollen and granular; a considerable number of nuclei cannot be seen, while the remaining ones, in general, stain irregularly

Fig. 4.—Cirrhosis of the liver.

and are swollen. The lobules which show only cloudy swelling are adjacent to the degenerating ones. There is some evidence of regeneration of the liver cells, at the periphery of the lobules especially (Figs. 5 and 6).

Microscopic Appearance of the Central Nervous System.[1]—Upon macrotomic section the central nervous system, with one exception, namely, the lenticular nucleus on both sides, appeared normal. There were no gross lesions discernible in the

[1] From Neurological Bulletin of Columbia University, June, 1918.

cortex or medullary substance. The internal capsule showed nothing demonstrable in the gross. The midbrain, pons and isthmus, cerebellum, and spinal cord were normal. The coverings of the brain showed no pathologic condition.

Upon inspection of the macrotomic sections in the gross, those containing the lenticular nucleus showed that this part of

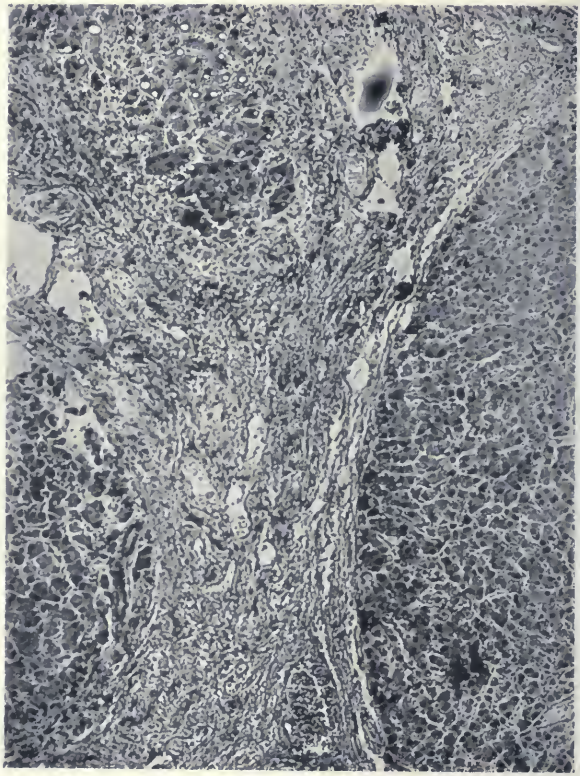

Fig. 5.—Hepatic hyperplasia.

the corpus striatum was the seat of some pathologic change. The lesions were minute and gave the putamen a spongy appearance. This was more particularly true in the dorsal or superior portions of the putamen and was likewise more pronounced in the region bordering upon the retrolenticular por-

tion of the capsule than in the areas contiguous to the anterior limb of the capsule. Microscopic study of the brain led to the following conclusions:

The cerebral cortex in all areas was normal in its cellular content and in its fasciculation. The vascular status showed no

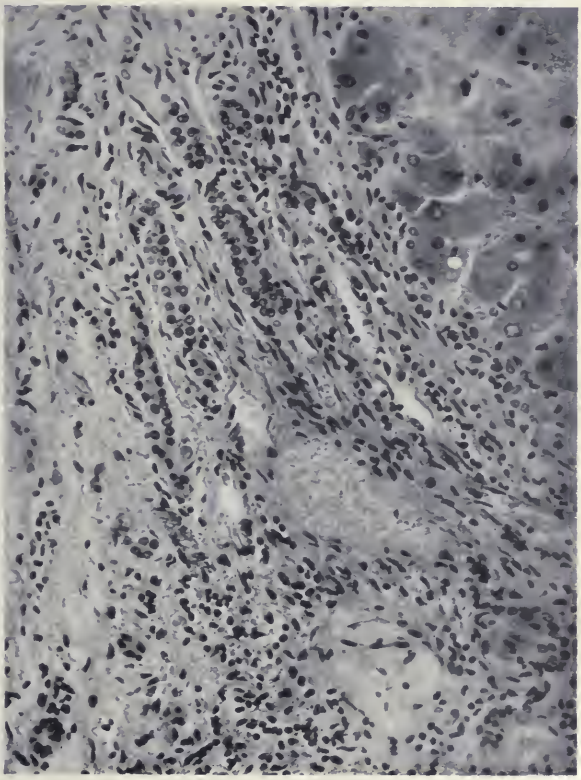

Fig. 6.—Character of cellular changes in the hepatic cells and also the proliferation of the bile-ducts.

pathologic alterations. The corona radiata and the centrum ovale as a whole were normal. The thalamus and hypothalamus showed no changes except that in the latter there was an apparent attenuation in the bundles of fibers which go to make up the ansa lenticularis. The infundibulo-mammillary region

was normal; the hypophysis in its glandular and neural portions showed no abnormal changes. The epithalamus, including the habenular region and the epiphysis, were normal. The metathalamus showed no alteration. There was no evidence of degeneration in the fibers of the midbrain and it was difficult to discern any appreciable change in the nucleus ruber. The isthmus, pons, cerebellum, medulla, and spinal cord revealed no pathologic alterations in their cell constituency or nerve-fibers.

The microscopic appearance of the lenticular nuclei of both sides was striking. Such pathologic changes as one noted were confined to the putamen and were more pronounced in the regions of this structure already mentioned in the description of the gross alterations.

A. The Cells in the Putamen.—The larger pyramidal elements, especially, showed a marked degeneration; in some places these cells had been entirely destroyed, leaving in their place a number of lacunæ about which were collected ameboid glia cells and other cellular elements which were regarded as plasma cells. In the areas where many of the nerve cells had disappeared in this manner, the putamen gave the impression of a beginning cavitation as illustrated in the accompanying photomicrographs (Fig. 7). In many regions the smaller pyramidal cells, as well as those of the larger variety, showed definite tendencies toward degeneration. Their nuclei were eccentrically placed, the cells appeared swollen, and their tigroid bodies were difficult to distinguish. From the general picture of the cellular alterations it seems fair to conclude that a diffuse parenchymatous degeneration was in process of development throughout the entire putamen. In the areas where it had reached its greatest intensity a process of cavitation had already been established.

B. The Fibers of the Putamen.—Even in the Pal-Weigert preparations it was difficult to detect any marked degree of fiber degeneration, although in some places there seemed to be a decrease in the myelin sheaths of some of the axis-cylinders.

C. Neuroglia.—Throughout the entire lenticular nucleus there was a marked degree of gliosis. This reached its greatest intensity, however, in the putamen, the latter standing out in

marked contrast to the head of the caudate nucleus, which appeared to present no change in the neuroglia.

D. Blood-vessels and Perivascular Spaces.—Throughout the entire extent of the putamen the blood-vessels seemed to have shrunk away from the adjacent tissue and to be surrounded by

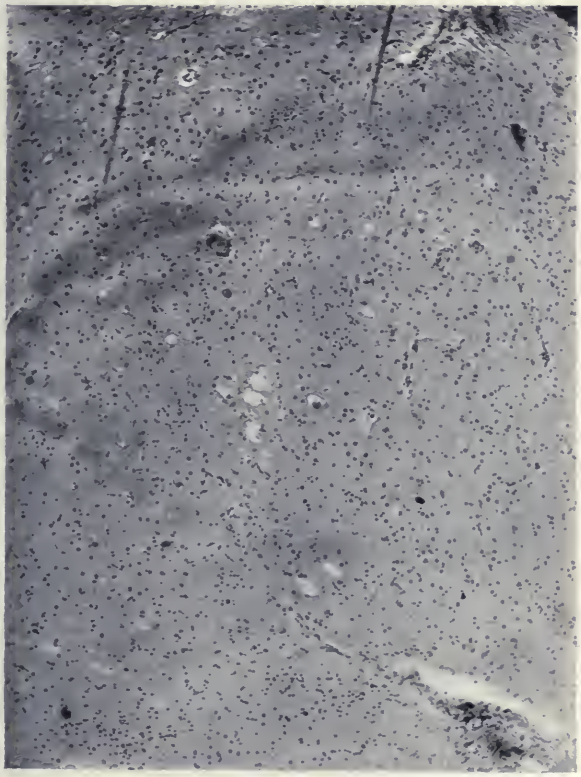

Fig. 7.—Gliosis in the putamen and beginning cavitation.

large, irregular spaces (Fig. 8). These, however, must not be considered as perivascular lymph-spaces and, indeed, it is doubtful whether they are of moment in the pathologic process at all. They may well be artifacts and are simply mentioned in this connection as their occurrence has been noted in the pathologic observations of other reported cases. One reason for making it

seem likely that these irregular spaces are artifacts is that their occurrence in this particular brain is not limited to the lenticular nucleus, but rather diffusely scattered throughout several parts of the central axis. The perivascular lymph-spaces were not distended nor did they contain any cellular elements which might be considered abnormal, either in amount or character.

Fig. 8.—Gliosis in the putamen and changes about blood-vessels.

The conclusions drawn from the pathologic study of this brain are that the lenticular nuclei of both sides were in a state of degeneration which probably was progressive. No portion of the brain showed any unusual biliary or other type of pigmentation.

Clinically, there are two distinct types of this disease: one *acute* or *subacute*, the other *chronic*. The two types differ very little except in the rapidity with which the invariably fatal termination occurs. The acute cases are apt to have some febrile disturbance; their duration is usually four to twelve months. The chronic cases may last from one to four years after the first appearance of the symptoms.

The striking and characteristic symptoms of the disease are disturbances of motor function.

1. *Tremor* is one of the outstanding features. It is usually one of the earliest and one of the most marked symptoms. It is increased by excitement, or if attention is drawn to it, or by voluntary effort. The range is apt to be fine, at least at the outset, but with volitional movement the excursions become wider. In the advanced stages it involves the head and trunk as well as the limbs. It disappears during sleep.

2. *Spasticity* or, better, hypertonicity is the second of the cardinal symptoms. Beginning in the limbs, it later spreads to the rest of the volunatry musculature, with one solitary exception—the extrinsic ocular muscle. Their movements remain quick and free. If one takes hold of one of these hypertonic arms or legs and tries to impress on it alternating flexion and extension, he is at once conscious of a considerable degree of resistance in the opposing muscles. It evidently consists in a generalized condition of increased tone in all the muscles indiscriminately.

Every patient reported has shown contracture, usually with the flexion contracture accentuated. This symptom is merely a result of the hypertonicity.

3. *Dysarthria* and *dysphagia* are almost invariably present. They, like the contractures, are the result of the hypertonicity. The dysarthria is characterized by the slurring element without the staccato element of disseminated sclerosis.

4. *Muscular weakness* and *emaciation* develop, associated with the contractures and immobility of the limbs. A considerable degree of voluntary power, however, has remained in the majority of cases. The weakness and wasting of the muscula-

ture are doubtless due in part to the atrophy of disuse and in part to the disturbance of metabolism.

5. The symptoms so far enumerated have all dealt with motor disturbances. Sensory symptoms, except for pains in the limbs mentioned in some cases, have not been observed. Examinations failed to reveal any change in sensibility, nor has any definite alteration of the tendon or cutaneous reflexes been found. Toward the end of most of the cases, however, it has been recorded that the organic reflexes became impaired. This Wilson attributes partly to mental deterioration, partly to loss of voluntary control over the muscles. His efforts to find a lesion in the cord were quite negative.

6. *Psychical symptoms*, though present in some form in most of the cases, have been very variable. Simple-mindedness, failure of memory and of mental powers, emotionalism, change in disposition, transient delusions, hallucinations of hearing, excitement, narrowing of the mental horizon, facility, docility, and childishness are some of the terms used to designate the mental disturbance. Attempts to classify these symptoms have been fruitless, but it seems probable that some psychical disturbance forms an integral part of the clinical picture.

7. *Significant negative signs* are the following: the optic disks and pupillary reactions are normal; there is no nystagmus; there are no cerebellar symptoms.

Concerning the etiology and pathogenesis of the disease there are some features worthy of note:

1. *Age.*—Progressive lenticular degeneration is a disease of adolescence and youth. The age of the youngest was ten years at the onset; of the oldest, twenty-six years. The average age is about fifteen years.

2. *Sex.*—Males and females are about equally affected. It is worthy of note that in the reported cases, menstruation, if established prior to the onset of the disease, almost invariably ceased. The significance of this is obscure.

3. *Heredity.*—Records of family nervous disease or neuropathic tendencies are not found in the reported cases. About

three-fourths of the cases are familial. There are two reports of three cases occurring in children of the same family.

4. No constant so-called *predisposing causes* are evident in the histories.

It has been suggested that the disease is an expression of a degenerative tendency—an abiotrophic defect—but it is quite striking that the observers of the reported cases almost uniformly have stated that their patients had normal mental and physical development prior to the onset. It seems highly improbable that a congenital tendency to degeneracy should lie so completely latent for twelve, fifteen, or twenty years.

Speculation as to the intimate nature and pathogenesis of the disease is perhaps interesting, but in the light of the available facts and absence of experimental proofs, rather fruitless. There are one or two philosophic considerations, however, which are worthy of note. There seems to be no analogy for such a distinct morbid entity whose most striking characteristic is a specific association between disease of one of the viscera and disease of a particular part of the gray matter of the central nervous system.

In any discussion of the etiology syphilis must be considered. Most of the cases recorded occurred in the pre-Wassermann days, but the observers were on the alert to discover signs of syphilis and the absence of positive evidence of either acquired or inherited syphilis is striking. In the more recently reported cases, unquestionably conforming to the syndrome, the Wassermann has been negative. Homén made specially exhaustive efforts to prove that his three cases were syphilitic, but despite his conclusion that they were probably of the nature of a so-called parasyphilitic condition, he specifically states that positive evidence of syphilis, either in parents or children, was wanting. Moreover, the cirrhosis differs from that of hepatic syphilitic cirrhosis in children. The latter is quite constantly associated with ascites.

Alcohol could not be shown to have played a part in the etiology. The presumption, therefore, arrived at by Wilson is that the disease, although familial, is acquired and is toxic in

origin, and that the toxin has a selective action on the lenticular nucleus. A very significant analogy to such a hypothesis is furnished by the observations of Werneke, Schmore, Esch, and Pfannenstiel who have described cases of icterus gravis or neonatorum. This disease is familial, occurs in the earliest days of life, and is fatal in a very short time, the infants rarely living more than a week or two. The interesting feature is that in addition to the general bile-staining of the tissues of the body, there is a selective action in the cerebrum and central nervous system. The lenticular nucleus, the corpus Luysi, the cornu ammonis, the dentate nucleus and the olives, the sensory nuclei of the medulla and pons are specially singled out and stained a bright yellow. The corpus Luysi and lenticular nucleus stain with the greatest intensity. Microscopically, the bile pigment is found in the bodies of the nerve cells. The patients, however, show no symptoms referable to the nuclei. In ordinary cases of jaundice in older people from whatever cause, and in jaundice of congenital bile-duct obliteration, no such selective staining of the gray matter has ever been observed as taking place.

As to the prognosis of the disease, all of the cases reported up to this time have proved fatal in one to four years. Treatment is unavailing in the cure of the condition. It is, therefore, confined to palliative therapy and symptomatic relief.

CLINIC OF DR. WALTER L. NILES

BELLEVUE HOSPITAL

SUBACUTE NON-TUBERCULAR PULMONARY INFECTION

Three Illustrative Cases; with Differential Diagnosis from Tuberculosis. Management and Treatment.

May 8, 1918.

CAREFUL, sometimes prolonged, investigation enables one in the great majority of cases to make a diagnosis and satisfactorily classify the disease. Occasionally, however, we encounter a case or group of cases which exhibit variations from the types with which we are familiar and accounts of which are not found in the text-books. These, of course, excite our interest much more than do the routine cases and stimulate a search of the literature, which is almost always rewarded by finding reports of similar examples and more or less complete descriptions of the condition.

We have two cases in the service, both of which have been in the hospital for a number of weeks and which we have very carefully studied. For want of a better name we have to call them "subacute non-tubercular pulmonary infection." The name means very little except that it does place them outside the tubercular group, which, after all, is perhaps the most important point. It tells nothing of the morbid anatomy and it is probably best to be non-committal in this respect, for we know very little about it.

CASE I.—This first patient is an Irish laborer, aged forty-two years. He was admitted on March 23, 1918, complaining of pain in the left side of his chest and fever. He has probably taken more alcohol than has been good for him; but has had no serious illness or operation. He denies venereal infection.

On March 20, 1918, he had been feeling quite as well as usual, except that during the previous three weeks he had a cough, which was evidently not very severe and was unaccompanied

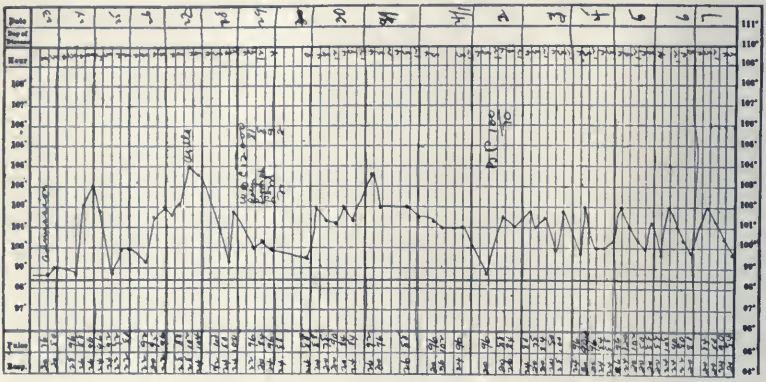

Fig. 9.—Chart of Case I.

by sputum, when he was seized with a very severe pain in the left side of his chest. He had no chill and at that time was not conscious of fever. The cough became aggravated, but there was still no sputum, and, indeed, at no time has he had

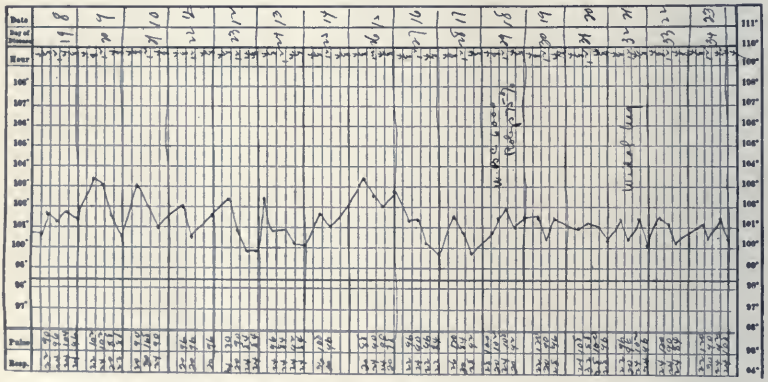

Fig. 10.—Chart of Case I.

but very little, it having been difficult to get proper specimens for examination. He does not recall that the pain was aggravated by the cough or by deep breathing. He thought that he had

lost about 5 pounds in weight during the three weeks which he had coughed. At the time of admission he felt comfortable except for a sense of discomfort in the region of his left hypochondrium and feverishness.

On referring to his chart (Figs. 9–11), you will notice that his temperature was practically normal on admission, but it soon rose, and since that time he has had more or less fever, which has generally been quite continuous in type, with a very gradual defervescence until the present, when it has almost reached normal. During all this time his respirations have been increased scarcely at all and his pulse has been just about in proportion to his

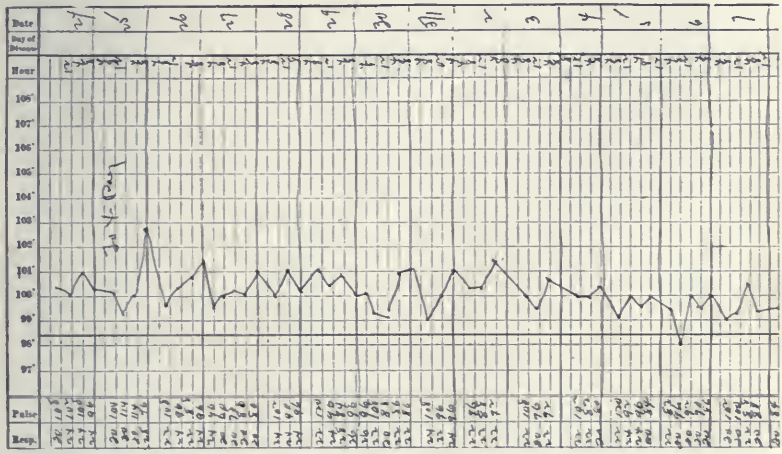

Fig. 11.—Chart of Case I.

temperature, very rarely faster and frequently distinctly slower. What little pain he had quickly subsided, and most of the time he has said that he felt perfectly well. He has coughed very little at any time, and during the past two weeks has rarely coughed at all. Such specimens of sputum as we have been able to collect have showed a variety of organisms on examining smears. On culture, the predominant organism has in each instance been a pneumococcus, Type IV, accompanied by non-hemolytic *streptococci* and Micrococcus catarrhalis.

On the day after admission his leukocytes were 12,000, with 81 per cent. of polymorphonuclear cells and 8 per cent. of

lymphocytes. That is the highest count which has been observed. One taken yesterday showed 6000 leukocytes, with 75 per cent. of polymorphonuclears.

He is, as you see, well nourished and has maintained his muscular development surprisingly well. He has at no time looked very ill, his tongue has been moist, and his cardiovas-

Fig. 12.—Case I. Scattered areas of infiltration throughout the left lower lobe.

cular and gastro-intestinal systems have been perfectly satisfactory. Examination of his chest was entirely negative except for a small area over the middle of the left lower lobe posteriorly, where there was a moderate impairment of resonance, a slight increase in fremitus, rather soft, low-pitched tubular breathing, and a great many fine and medium sized moist râles. The signs are now exactly the same, except that the

râles are somewhat less numerous and a little drier in quality.

Fearing that he might possibly have an empyema, a needle was introduced, but no fluid was obtained.

We have twice had his chest *x*-rayed and the plates are before you. You will notice that there is quite a large area in the lower portion of the left chest where the density is decidedly increased. This area is quite irregular in outline, varies considerably in density in its different parts, and is rather spotted. It does not, however, have the appearance of a tuberculous lesion, several examples of which I have recently shown you. Dr. Hirsch thinks there is some evidence of cylindric bronchial dilatations, particularly at the points indicated by the arrows. Elsewhere the lungs are perfectly normal in appearance (Fig. 12).

Case II.—The next patient, a colored boy eighteen years of age, was admitted to the hospital on April 2, 1918, complaining of fever.

He says that his father died at about fifty after one year's illness, the exact nature of which he does not know. Of course, tuberculosis is to be suspected with such a history, particularly in a colored person. His mother is, however, alive and well, and he has four brothers and four sisters, all of whom are perfectly healthy. One brother died from an accident at eight years of age.

He is employed as a laborer removing ashes from a factory. His habits have been good. His previous personal history is, however, of interest and very likely of significance. In 1911, while living in South Carolina, he was sick for three months with what he calls "typhoid pneumonia." He was in bed for two months. The onset was slow, he had a cough throughout the illness, and he recalls that he was greatly troubled by a pain in the left side of his chest. His sputum was never bloody. He apparently made a good recovery, but in 1913, when living in North Carolina, he had "malaria," which lasted for about three months. Again he coughed and had pain in his left chest throughout the illness. Since that time he has felt perfectly well, having had no cough or dyspnea and has maintained his usual weight.

The present illness began on March 26, 1918. The onset was gradual, with a feeling of general malaise, fever, and cough, which was accompanied by small amounts of white expectora-

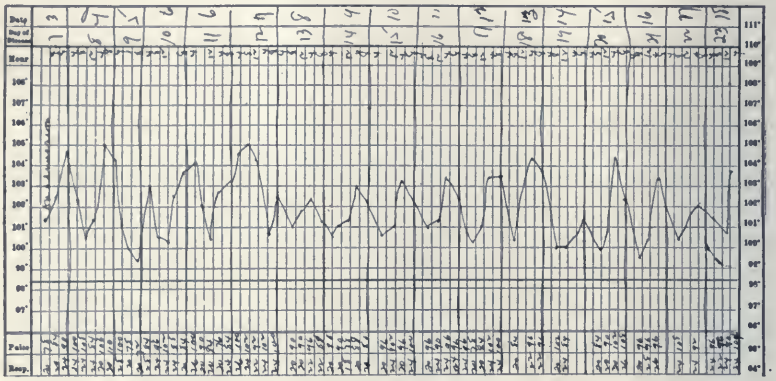

Fig. 13.—Chart of Case II.

tion. He had been up and about until his admission to the hospital, being referred here from the Cornell Dispensary.

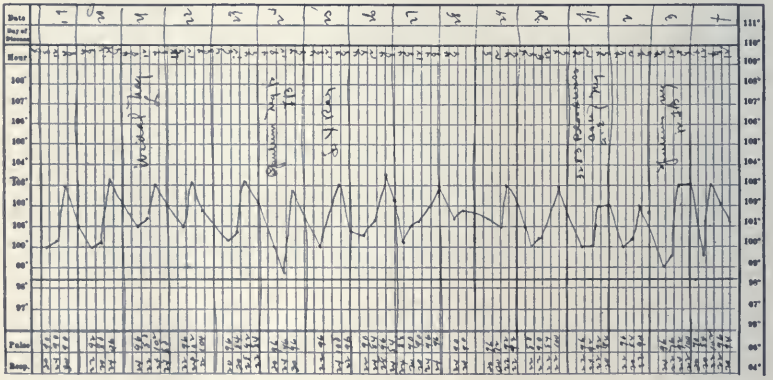

Fig. 14.—Chart of Case II.

Study of his temperature chart (Figs. 13–15) shows that it has been much more irregular and has averaged somewhat higher than that of the last patient. The tendency has lately been somewhat downward, though it reached 103.4 F. yesterday

afternoon. It is normal this morning. He has had no chills or sweating. His respirations have not been accelerated and his pulse has generally been rather slow in proportion to his temperature.

Several blood examinations have showed 10,000 leukocytes as the highest count. Yesterday the leukocytes were 8500, with 72 per cent. of polymorphonuclears and 26 per cent. of lymphocytes.

Upon admission his physical examination was curiously negative. I was unable to detect any abnormalities in his lungs, and it was not until after he had been here a week that I noted

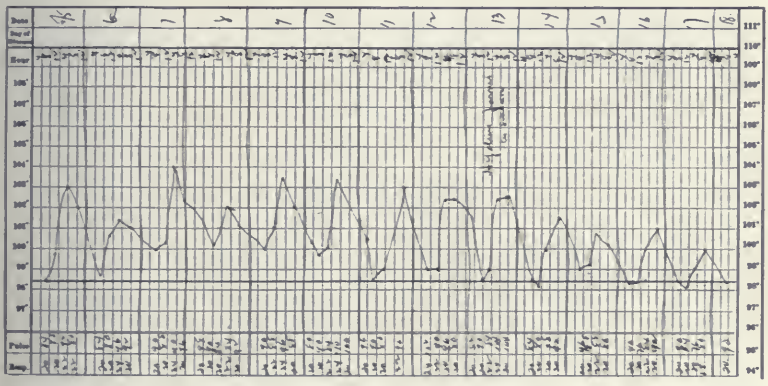

Fig. 15.—Chart of Case II.

slight dulness and a few persistent fine crackling râles at the end of a deep inspiration over the left lower lobe. Later quite large showers of crepitant râles were heard, yet there was no change in the breath sounds; neither was the fremitus modified. These signs—dulness and fine râles—have persisted to the present time.

We at first thought he certainly must have pulmonary tuberculosis. That suspicion is, of course, always more pronounced when considering sick colored people, but in the absence of the usual mainfestations of typhoid fever, together with negative blood-cultures and Widal reactions, it seemed quite justified despite the absence of physical signs and his slow

pulse. Repeated examinations of his sputum have been negative for tubercle bacilli, though, of course, these negative findings do not rule out the disease. Cultures of his sputum have showed Type IV pneumococci together with Micrococcus catarrhalis.

Perhaps I should emphasize the fact that his blood Wassermanns have twice been negative, with both alcoholic and choles-

Fig. 16.—Case II. Notice a small patch of peribronchial infiltration seen at the left base behind the ninth rib posteriorly. Enlargement of lymph-nodes at the roots of both lungs.

terinized antigens. Syphilis of the lung is occasionally seen—we have recently had 2 cases—but I have never known it to be accompanied by so much fever as this boy has had.

A radiogram of his chest is now before you (Fig. 16). You will notice that there is an area of increased density which appar-

ently lies at the extreme base of the left lung. It extends downward in the direction of the bronchi and is probably evidence of peribronchial infiltration. This irregularity of shadow along the dome of the diaphragm is indicative of pleural adhesions, and you see there is a similar appearance on the right side as well. The mediastinal shadow is wide and irregular, especially at the roots of the lungs, and indicates an adenopathy of the mediastinal and peribronchial nodes. The upper lobes are perfectly clear and there is nowhere the appearance of a tuberculous lesion.

I think it is safe to say that this case is very similar to the previous one. The lesion is not quite so extensive, though the constitutional symptoms have been more pronounced. Yet the general picture is about the same.

Case III.—I have also brought the temperature chart (Figs. 17–19) and radiograms from a similar case which I have been following the past winter. The patient is a man thirty years of age, and his history, which goes back to 1906, illustrates more diverse and extensive effects from an infection quite similar to the ones I have related.

He was always perfectly well until sixteen years old, when he had an attack of fever accompanied by pain in the right side of his chest, which was called "grip." It was not very severe and the temperature continued for only ten days. A week after its subsidence jaundice developed. This lasted for six weeks, during all of which time he coughed and had some discomfort in the region of his liver. He lost weight moderately, but apparently made a perfect recovery and was well for three years. His symptoms then became referable to his gastro-intestinal tract and were those of intestinal intoxication. His bowels became increasingly constipated and he suffered with frequent bilious attacks with headache. For three years he had various sorts of treatment, but got progressively worse, and in 1913 a laparotomy was done. It was reported that he had chronic appendicitis with adhesions, his appendix being removed and the adhesions liberated. He felt better for six weeks, at the end of which time his symptoms began to return,

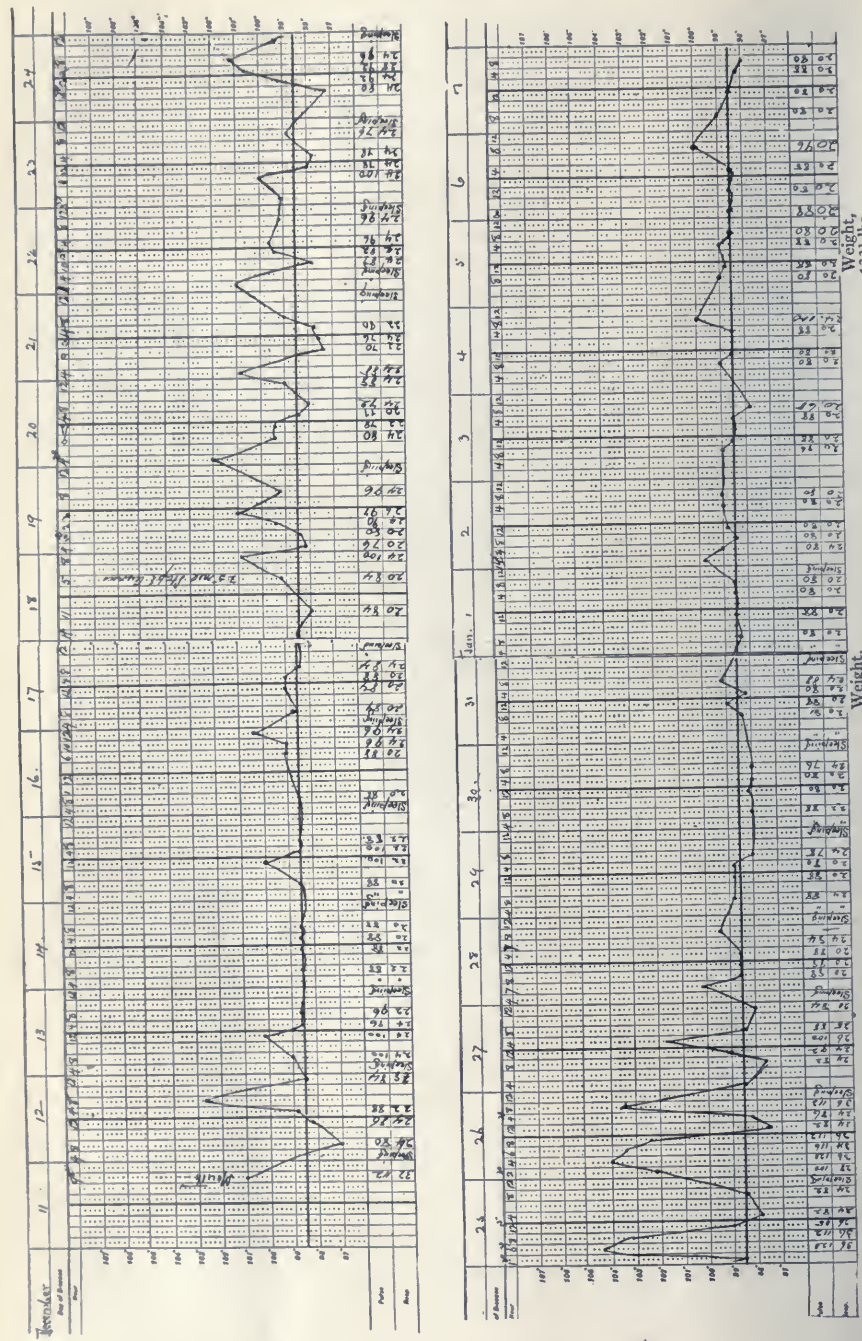

Fig. 17.—Charts of Case III.

and in a few months he was just as badly off as before. During the next four years he spent a considerable part of his time in various sanitaria. Gradually his symptoms became more definitely referred to his epigastric region, and in April, 1917, he was again operated. This time chronic cholecystitis with surrounding adhesions, which caused a partial obstruction of the duodenum, was revealed. There was also a band of adhesions extending from the gall-bladder to the transverse colon. Numerous other smaller bands were found connecting coils of intestine, particularly in the liver region, the surface of which

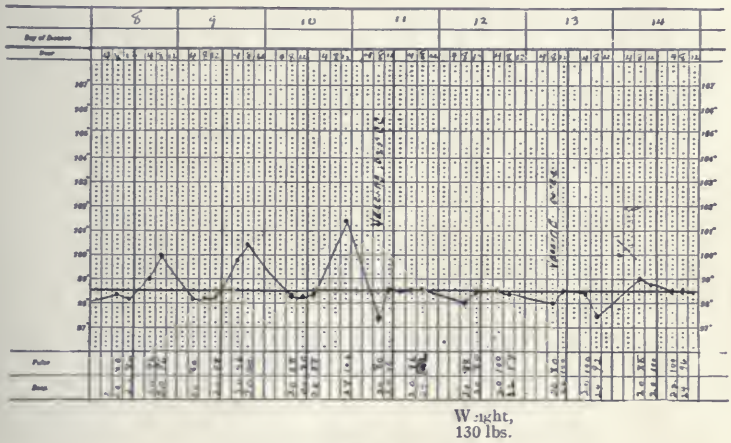

Fig. 19.—Chart of Case III.

was lusterless and evidently thickened. He doubtless had a low grade of chronic peritonitis. Following this operation his abdominal symptoms improved somewhat.

In June, 1917, he had an attack of fever accompanied by a non-productive cough. He was then seen by Dr. James A. Miller, who radiographed his chest and had his sputum cultured. The cultures showed Type IV pneumococci and the radiograms showed thickening of the pleura over the bases of both lungs and some infiltration in the right lower lobe.

All during this period of four to five years he recalls occasional attacks of fever, which usually lasted only a day or two and which were ascribed to intestinal intoxication or "grip."

During the summer of 1917, while he gained a little in weight, the periods of fever became more frequent, and in September he developed a temperature of 103° F., which lasted for about ten days. During this time he had a very persistent non-productive cough, but there was no pain in his chest. All during the fall these short attacks of fever continued. In December, 1917, the fever became more continuous, and I first saw him at that time. The striking feature on examination was an enormous number of crepitant râles over the bases of both lungs posteriorly, more especially on the right side, extending nearly up to the hilus. About Christmas, as you will see by his chart, his temperature rather suddenly rose to over 104° F., and fluctuated widely, but with a rapid defervescence during the next five days. Since that time frequent recurrences of fever have interrupted his convalescence, which has been very tedious. Whenever his temperature was even a little elevated he would cough almost incessantly, but there has been scarcely any expectoration, so that it has been impossible to get satisfactory specimens for bacteriologic study. One specimen collected on December 3, 1917, showed a pure culture of *Staphylococcus aureus*. Another, on December 10th, gave the same result. December 19, 1917, a specimen gave mostly influenza bacilli, with a few colonies of *staphylococci*. Another examination on April 8, 1918, showed mostly *staphylococci*, with a few colonies of *streptococci*. All specimens have been negative for tubercle bacilli.

Blood examinations have showed a moderate degree of secondary anemia with a slight leukocytosis. At the height of his fever the leukocytes were 13,600, with 83 per cent. polymorphonuclears. They had previously numbered 7300, with 87 per cent. polymorphonuclears, and subsequently showed 11,200, with 89 per cent. polymorphonuclears, and still later became normal.

All during his illness it has been difficult to determine any localized signs. Over the midportion of the right lower lobe there has been a little dulness and a slight, though definite, tendency toward tubular breathing. The crepitant râles which

I have mentioned were exceedingly numerous, and at the present time, while his general condition has greatly improved, there are still a great many râles on both sides, but more especially on the right.

Radiograms taken by Dr. H. M. Imboden, at the height of his fever, show a very sharply defined area of infiltration extending in a somewhat wedged shape from the hilus of the lung to the periphery. The edges are quite clearly defined and the density is quite uniform. You will notice that the heart is pulled over to the right; also on both sides there is a cloudiness over the lower portions of the lungs, together with irregularities in outline indicative of pleural thickening and adhesions.

These radiograms, made on January 14, 1918, show that the shadow of infiltration is much less dense, while the other features remain about the same.[1] Please notice that in all of these plates the upper portions of the lungs are perfectly clear.

While it is, of course, impossible to say positively, it is my impression that this young man's illness began with his attack of so-called "grip" in 1906, which was, in reality, an inflammation of a portion of his right lung and pleura; that this focus has remained more or less active ever since and that his peritonitis and cholecystitis were secondary lesions. That the infection is not tuberculous seems to be established by the course of the disease and the radiograms.

In the first case the present attack is apparently the first, and probably marks the beginning of his pulmonary trouble. The colored boy's pulmonary lesion probably began in 1911, when he was ill with what he calls "typhoid pneumonia." He had a similar recurrence in 1913, and the present attack is evidently of the same nature as the previous ones. The third case which I have described appears to have lasted for thirteen years, with many exacerbations, mostly mild, the last one having been more severe than any of the others.

You will note that they all have a number of featurse in common. While there have been many evidences of toxemia,

[1] Roentgenograms made May 14 and June 24, 1918, are aso shown in the text.

fever has been out of proportion to all the others. They have had little leukocytosis, the pulse has not been remarkably increased, and the nutrition has been surprisingly well maintained. In all of them the lesion has been in a lower lobe, physical ex-

Fig. 20.—Case III. Taken December 27, 1917. Shows large dense area of infiltration in right lower lobe.

amination and radiograms giving evidences of infiltration of the peribronchial tissues. Tuberculosis has very naturally been suspected in all of them, but can now be quite definitely ruled out.

Now these cases do not correspond with any text-book description with which I am familiar, yet they are not very infrequently seen, and are probably given a great variety of diagnoses.

Fig. 21.—Case III. Taken January 14, 1918. Shows infiltration less dense and less extensive, especially in lower portion.

My own interest in this type of case has been stimulated by a report by James Alexander Miller in the American Journal of the Medical Sciences for December, 1917. He reported a series of 22 cases, few of which were as severe or prolonged as

these, but which had the same general characteristics. He divided his cases into three groups: First, a subacute type, in which the constitutional disturbances are moderate and of short duration, but in which the physical signs persist from six weeks

Fig. 22.—Case III. Taken May 14, 1918. Area of infiltration now quite mottled and outlines irregular.

to four months, but end in perfect recovery. Second, a subacute type with recurrences, in which the attacks are the same as in the subacute type, but with one or more recurrences at intervals of several months or years. He notes that the phys-

ical signs appear in the same portion of the lung as in the previous attack, from which he assumes that the condition is a recurrence and not a new infection. Third, a chronic type in which the abnormal signs have remained fairly constant for a

Fig. 23.—Case III. Taken June 24, 1918. Shows appearance of diffuse, irregular fibrosis of the right lower lobe.

period of years. Several other American writers have also described groups of very similar cases, and they have all emphasized the decided suspicion of tuberculosis, but have been satisfied to rule it out after prolonged observation.

Pneumococci have been found in the sputum of a majority of the cases reported. Influenza bacilli are next in frequency, and various types of streptococci are occasionally mentioned.

The pathology is obscure because the disease is rarely fatal, only one necropsy having been reported. That was Hamman and Wollman's case, in which the lesion was found to be a localized bronchitis, with infiltration of the bronchial wall and foci of bronchopneumonia about the smaller bronchi. From the physical signs and the radiograms it seems fair to conclude that the lesion is always of that nature. That raises the question whether a lobar form of bronchopneumonia ever occurs. Of course, a non-tubercular bronchopneumonia usually involves all of the lobes, but that there are exceptions cannot be doubted. A localized bronchopneumonia has been experimentally produced in animals, and we have had several examples in humans coming to necropsy during the past year.

The *x*-ray findings are not uniform. Miller notes that 3 of his subacute cases gave normal roentgenograms, and I recall 2 cases which I have followed for several years in whom the radiograms are negative. In these the foci of inflammation are evidently very small and discrete. In others the areas are quite large, as in the ones shown you. I recall 2 cases which have been in the hospital several times and which we eventually classified as chronic interstitial pneumonitis, as they gradually developed contraction of the chest with dislocation of the heart, and one of them has a large bronchiectatic cavity. Thus you see the lesion varies from very minutes size to large areas involving all of one lower lobe. The chronic cases with extensive pulmonary changes usually develop a purulent bronchitis which greatly impairs their health and eventually gives a picture of chronic sepsis.

When you see such cases as these you must, of course, carefully consider the possibility of a tubercular origin, and a few years ago we probably diagnosed most of them as tuberculous. They emphasize the fact, however, that a good rule to have in mind is that when physical signs are confined to the lower half of the chest, the lesion is probably not tubercular. Con-

versely, when the physical signs are confined to the upper half of the chest, the presumption is strongly in favor of tuberculosis.

The prognosis in this type of infection is very doubtful. It seems probable that the second and third cases will have recurrences and eventually develop fibrosis of the lung, with contraction and bronchiectases. The first man has a better chance than the others to overcome his infection, but I have seen none completely recover which were so severe or prolonged.

There is little to say regarding treatment, as we must chiefly rely upon fresh air, rest, and the maintenance of nutrition. I have given autogenous vaccines in several cases, but with doubtful results, though a few mild, chronic cases without extensive pulmonary changes I am sure have been benefited. During acute exacerbations some of them have a peculiar persistent, harassing, non-productive cough. This is remarkably relieved by acetanilid in 2- or 3-grain doses, repeated every fifteen minutes for four doses if necessary. Gavin, Lyall, and Morita have recently emphasized the importance of posture which favors pulmonary drainage. This treatment is undoubtedly of value in abscess of the lung and bronchiectasis, and I have no doubt it is also beneficial when there is extensive bronchitis with considerable exudation, but in most of my cases this has not been a feature, and I cannot see how postural treatment would be helpful in these patients.

Subsequent Notes.—Case I continued to improve, though his temperature rose to 100° to 101° F. every few days, and left the hospital June 13, 1918. His physical signs remained unchanged.

Case II had a moderate, irregular fever until June 6, 1918, when his temperature became normal and remained so until he was discharged on June 24th. Dulness and a few râles persisted.

Case III has also improved, but he has some fever every week or two, and his physical signs, while less extensive, are otherwise unchanged.

CONTRIBUTION BY DR. CHARLES B. SLADE

MUNICIPAL SANITARIUM, OTISVILLE, N. Y.

THE RELATION OF PULMONARY TUBERCULOSIS TO GENERAL PRACTICE

Consideration of Symptoms and Their Relations; Loss of Weight, Strength, and Appetite; Digestive Disorders, Dyspnea, Rapid Pulse, Fever, Pain, Cough, Hoarseness, Sputum, Night-sweats, Hemorrhage, and Menstrual Disturbances (in Women). Diagnosis, General and Differential. Treatment. Prognosis.

THE vast bulk of recent writings, as well as work, upon tuberculosis quite properly deal with highly specialized efforts to understand and control this disease. It is only by intensive concentration of effort that fundamental advances have been made in our knowledge of disease. Those of the medical profession who are devoting their lives and energies chiefly or exclusively to some specialty can only stimulate and aid progress among their co-workers by adhering closely to their ideals in work and writing, often at the sacrifice of general human considerations. It is the office of the general practitioner to co-ordinate as perfectly as possible the knowledge discovered by the specialist with that complex, sentimental, and very imperfect human being—his patient. In no other specialty is this so true as in tuberculosis, for the simple reason that it is the commonest disease of human flesh.

To the special worker, whose almost every thought and act has been devoted for years to means for defeating the tubercle bacillus, the frailties of human nature that stand in his way are intolerable. He is pursuing an ideal. To him it is unthinkable that any passing human desire or appetite should be suffered to

interfere with the absolute eradication of this universal enemy. The microscopist, the bacteriologist, and the pathologist, wrapt in the infatuation of their quest and apart from all human distractions, discover some profound truth in the life history or vulnerability of the tubercle bacillus. The special clinician, whose life's work is only a shade less consecrated to the single objective, receives the new knowledge and evolves rules for the application of this knowledge to the control and eradication of the disease. To them the chain is complete. Their facts and theories are incontestible. The goal is in sight and the way is clear, except for one consideration, a consideration which is dim or lost to the sight of the specialist, but which looms large to the general practitioner—the incalculable variations in the human family.

In general practice human beings are first children and men or women, and patients secondarily. To the specialist, especially the laboratory worker, disease and health are absolute terms; to the practitioner they are both relative.

The special clinician gives absolute rules for the control of tuberculosis. They are reasonable because they are based upon facts and have a worthy object. It is the clinician's duty and desire to urge his patient to comply with these rules. The practitioner well knows, however, that absolute compliance is impossible to obtain, and that his patient must remain his patient on through life and into the Valley of the Shadow, to the end of this tortuous and varied trail. The special clinician gives a dictum, for he speaks to disease, his enemy. The practitioner gives advice, for he speaks to humanity, his friend. Concerning tuberculosis and pregnancy, Auvard's dictum is "The young girl should not marry, the married woman should not conceive, the mother should not nurse her child." The general practitioner agrees with Auvard, but must care for the young tuberculous girl who has married, must care for the mother who has conceived, and must care for the child whom its mother has nursed.

The specialists will continue to be the producers of new knowledge to help the general practitioner in his work with tuberculous patients. They can in special institutions apply with fair

accuracy their dictums, but first and last the diagnosis, treatment, and prognosis rests with the general practitioner.

Diagnosis.—Previous to discovery of the tubercle bacillus, in 1882, and to a diminishing degree for twenty years thereafter consumption (pulmonary tuberculosis) was shunned by physicians and laymen to such an extent that only after the hand of death was clearly seen upon the patient's every feature was the diagnosis pronounced. In common with other diseases in which the causative agent had been isolated, after 1882, evidence that the body had been infected by the tubercle bacillus was accepted as justifying a positive diagnosis of the disease. From a purely theoretic viewpoint, so-called scientifically, this was and still is true.

With the growth of tuberculosis sanatoria and a correct knowledge of the power of the human body, under proper conditions, to overcome tuberculous infection, there was a steady increase in efforts to establish the diagnosis as early as possible. It was, of course, obvious that the less the disease and the stronger the body, so much brighter would be the prospect of recovery once proper conditions were established. This eagerness to establish the earliest possible diagnosis (a complete reversal of the former attitude) grew to such extremes that in the first years of this century the diagnosis of tuberculous disease was pronounced in many cases upon the flimsiest evidence and the condemned were packed off to sanatoria to be "cured." Naturally, a surprisingly high percentage of sanatorium patients were discharged "cured." So the good reputation of the sanatoria soared far above their deservedly high value. Unfortunately, the term "cured" which tuberculosis specialists applied to their sanatorium graduates was not accepted by the laity at its face value. In the lay mind, as in many medical minds, there still lingered a remnant of the old belief that "once a consumptive always consumptive." Many of the young people who came from the sanatoria, though in perfect health, had difficulty in re-establishing themselves in work and normal social intimacies and freedom.

In a paper read before the New York County Medical Society January 23, 1911, I made the following statements: "We should

enjoin more care than is now generally exercised in fixing a positive diagnosis and recommending sanatoria in legitimately doubtful cases. . . . If we do not wish to bring upon us ultimately a well-deserved censure we must consider a negative diagnosis to be as important as a positive one." Though these words seem now quite commonplace, the discussion of my paper eight years ago left no doubt that I was moving against the current. Subsequent observation and knowledge have brought us to a realization that there is a wide difference between tuberculous infection and tuberculous disease. Probably 90 per cent. or more of all human beings who reach adult life harbor tuberculous infection. Not more than 20 per cent. ever have tuberculous disease. Increased experience has carried me even further than the stand I took in 1911. I now feel that in doubtful cases it is usually far worse to make an erroneous positive diagnosis of pulmonary tuberculosis than an erroneous negative one. The former can never be eradicated. The patient is branded for life, even though it is later said that his disease is "arrested" (which term is now correctly used instead of "cured"). If a negative diagnosis is erroneous, intelligent observation is almost sure to correct the error in time to accomplish all that could have been gained by an earlier diagnosis. Certainly this is the broader and more human stand to take. In this way, always on the alert, the general practitioner should lean to a negative diagnosis in doubtful cases until evidence develops which renders his position untenable.

When a diagnosis of most infectious diseases is made it either stands, or subsequent developments eliminate it by proving clearly that the symptoms were due to another disease or condition. Such is the case when a patient thought to have typhoid fever is found to have Plasmodia malariæ in his blood and no Widal reaction nor rose spots, and when a sweat brings the temperature to normal. So may a diagnosis of gall-stone impaction prove to be appendicitis, or a diagnosis of scarlet fever may turn out to be rötheln, and so on. It is not so when pulmonary tuberculosis is pronounced. Even when doubtful the diagnosis can rarely be excluded. Too often no other definite disease develops to take its place. Even though pneumonia, typhoid, or

influenza may develop or be diagnosed subsequently, who can prove that there is not tuberculosis in the lung besides? Therefore, we must be extremely cautious in pronouncing the diagnosis of pulmonary tuberculosis.

With the foregoing understanding I will proceed to the more detailed consideration of the diagnosis. The best general guide, when considering any given case, is to recall one or more individual patients whom we have been able to observe long enough to fix the significance of similar symptoms. It is upon the study and analysis of large groups of cases that we base our most impressive discussions and papers, but the physician learns and retains the most valuable knowledge for his future guidance from individual patients.

Children.—The extreme rarity of characteristic physical signs and the difficulty in obtaining sputum for examination in children under fourteen years of age renders a conclusive diagnosis impossible in the majority of suspected cases. Although tuberculin reactions are obtained in a smaller percentage of all persons under fourteen years than in adults, even here a positive reaction only signifies that the subject was at some time infected by tubercle bacilli. This is not the information we seek. We wish to know whether or not the patient is ill from tuberculosis, if he or she has tuberculous disease. Therefore, if its significance is wrongly estimated, a positive reaction may entail unjustifiable hardships and restriction upon the family and the patient. For the advancement of scientific knowledge it is permissable to employ the tuberculin skin tests, but not for the diagnosis of pulmonary tuberculosis. If interpreted by the clinician who has taken the history and physically examined the patient, *x*-ray findings may rarely be of help in diagnosis. In the vast majority of these little patients, however, when the history, bacteriologic, and physical findings leave us in doubt, the *x*-ray findings are either negative, vague, or confusing.

Cough, elevation of temperature, loss of weight, palpable cervical glands, and even râles in the lower lobes, due to acute infections, lead to many incorrect diagnoses in children. Distinct dulness on percussion with bronchial or marked bronchovesicular

breathing is rarely found in young children except over pneumonia or just above the level of an empyema. In fact, characteristic physical signs of pulmonary tuberculosis are so rare in young children that these evidences of pulmonary inflammation strongly suggest some other infection.

As stated, it is rare that tubercle bacilli can be demonstrated in pulmonary tuberculosis of children. In those who cannot be made to raise any sputum for examination, we may examine smears taken directly from the larynx. Bacilli discovered in this area, of course, clear up any doubt. But even this procedure, though it should be followed, is of help in only a very small percentage of cases.

We are, therefore, thrown almost entirely upon history and symptoms for the diagnosis in children. Family history as well as the history of other intimate associates is of importance. The parents, especially the mother, is most vital. When a child presents all other evidences strongly suspicious of pulmonary tuberculosis, if its mother is known to have had the disease when the child was born, a positive diagnosis should be made. Positive evidence of pulmonary tuberculosis in other intimates of the child is of like but less weighty importance as positive evidence. The conditions under which the child lived during such exposure should be considered. The less sanitary and the greater the degree of indoor exposure, the more likely was infection to have taken place. The known ingestion of tuberculous cows' milk could not be ignored as a possible source of the infection; but whether any considerable number of infections from cows' milk give rise to pulmonary disease has not been proved. It is at present felt that most human tuberculosis of bovine origin involves chiefly other body structures.

Those infectious diseases which involve specially the respiratory tract, such as pneumonia, measles, and influenza, are predisposing causes to the development of pulmonary tuberculosis in children as well as in adults. Though it is possible that these diseases prepare a fertile soil in the respiratory tract for implantation of tuberculous infection, it is more likely that they lower resistance and permit growth and spread of a previous latent in-

fection. No matter which is the true sequence, when symptoms and signs of pulmonary disease, with cough and temperature, continue for a month or more after the average duration of any of the acute diseases, and no other cause can be discovered, such as local or general sepsis, it is fairly safe to make a diagnosis of pulmonary tuberculosis. Diabetes mellitus, which is so commonly associated with pulmonary tuberculosis in adults, is rare in children.

The following are the commonest symptoms met with in pulmonary tuberculosis of children:

Pallor, or cold extremities.

Persistent evening temperature—99½° F. or higher.

Cough for one month or longer.

Dyspnea on moderate exertion.

Loss of, or failure to gain, weight.

Large palpable lymph-nodes.

Sweating on cool nights.

Prolonged loss of appetite.

Pain in chest, repeated or persistent, in the same area.

Hemoptysis, which must be carefully differentiated from nosebleed, which may occur at night, be swallowed, and later vomited.

Physical signs, especially persistent small or medium-sized moist râles in one or both upper lobes.

Normal puerile breathing is so like bronchovesicular breathing of moderate infiltration of lung that the breath as well as the voice sounds are rarely of value in children. Neither is dulness on percussion likely to be detected except in very rare instances.

When three or more of the above-mentioned symptoms are present in a child who is known to have been exposed to tuberculous infection a positive diagnosis should be made. An erroneous positive diagnosis in a child does not work the same injustive that it does in adults, especially young adults.

Adults.—The great variety of gross pathologic changes in pulmonary tuberculosis and the various ways that different human organisms respond to this disease in its early stages necessarily reduce the early diagnosis of pulmonary tuberculosis to a matter of individual judgment in a large percentage of cases, even in adults. Undoubtedly a difference in the toxicity of dif-

ferent strains of bacilli adds to the protean nature of the clinical picture.

The demonstration of tubercle bacilli is not always necessary to make a fairly reliable positive diagnosis, but the diagnosis remains uncertain in some cases until they have been found. Even though bacilli be discovered in the sputum early in our investigation, we should continue the classical process of diagnosis by exclusion to its completion. It is only by such means that we will avoid overlooking important complications. Graves' disease, heart disease, diabetes, nephritis, or any one of many serious diseases may be the dominant illness in a person who has pulmonary tuberculosis with bacilli in the sputum. Fortunately, the general practitioner has rarely to contend with the often biasing influence of a previous diagnosis. He works with virgin clay. The subject has usually been his patient from the beginning of symptoms and often for years before, perhaps from birth. If this gives him more freedom it also gives proportionately great responsibility. His diagnosis, right or wrong, when expressed unequivocally is very likely to stand. When the case is clear, he is almost sure to be right. When difficult, the diagnosis is apt to be a question of individual judgment, in which case a subsequent examiner, if he be a popular consultant, is not likely to disagree, first, because he could not prove his point, and second, because he would not continue to be popular. Therefore, one should lean to the negative diagnosis while providing for the patient's general health and continuing to investigate until either a positive or a negative diagnosis can be pronounced with reasonable certainty. If this cannot be done in a reasonable time, consultation may be sought at any time, but for diagnosis, where there is any room for doubt, the patient's physician will be much wiser to have his consultation before he expresses his opinion. Almost every symptom and physical sign known to medicine may be present in pulmonary tuberculosis. Yet any of them may be produced by other diseases.

There are two distinct types of clinical history of pulmonary tuberculosis: (1) The gradual or sudden appearance of symptoms or signs without preceding illness from other cause. (2) A failure

to properly recover from some other illness or injury, with the development of symptoms or signs suggestive of pulmonary tuberculosis.

Although pulmonary tuberculosis may exist to a varying extent without producing any symptoms or signs, the following symptoms are the most common, and two or more of them are present in nearly every case:

Loss of weight.
Loss of strength.
Loss of appetite.
Digestive disorders.
Dyspnea.
Rapid pulse.
Fever.
Pain.
Cough.
Hoarseness.
Sputum.
Night-sweats.
Hemorrhage.
Menstrual disturbances (in women).

Loss of weight, from any cause, may signify lowered resistance, which permits the development of pulmonary tuberculosis in one whose focus of infection would otherwise have remained latent. On the other hand, loss of weight may be a symptom and result of active tuberculous disease. Therefore, the loss of 5 per cent. or more of the individual's normal weight should be considered suggestive of pulmonary tuberculosis when another likely cause cannot be elicited. It is only suggestive and of no value in the absence of other symptoms.

Loss of strength, though more difficult to measure, occupies in the symptomatology of pulmonary tuberculosis a position similar to that of loss of weight. It may be either the cause or a result. Its value in diagnosis depends upon its relation to other manifestations or findings.

Loss of appetite, although more or less similar to the two foregoing symptoms in significance, appears to have a more consistent

relation to the disease in some cases. Especially does this apply to the appetite for breakfast. In some cases the first symptom complained of is either a loss of appetite or distinct aversion to food in the early morning. Though this symptom should be viewed with peculiar suspicion and pulmonary tuberculosis be always looked for in these patients, we must not lose sight of the fact that modern habits of life have developed this early morning aversion to food in a large percentage of otherwise normal people. Early morning nausea, so common in chronic gastritis from any cause, must not be mistaken for a symptom of pulmonary tuberculosis.

Digestive Disorders.—Besides loss of appetite for, or aversion to, breakfast, indigestion, pain, or discomfort after taking food and other evidences of disturbance of digestion are commonly experienced early or throughout the course of pulmonary tuberculosis. Hyperacidity, with its epigastric pain or discomfort, which is felt most frequently when stomach digestion should be almost complete, may be the first manifestation of pulmonary tuberculosis. Sour, acid, or bitter eructations, with or without gastric and intestinal flatulence, are common in these cases. Any cough or scanty sputum is usually ascribed to the "stomach" by these patients. Late in many cases of pulmonary tuberculosis the most distressing and uncontrollable symptoms are due to disorders of the stomach and intestines.

Dyspnea.—Early in the course of pulmonary tuberculosis it is difficult for many patients to know whether they experience shortness of breath or loss of endurance. They may tire more easily than they did formerly, but do they actually feel short of breath? Dyspnea, or lack of oxygen supply to the system, no doubt is a large factor in the production of tired feeling or lassitude. The individual's acuity of self-analysis determines which one he will complain of. Furthermore, people who habitually move slowly and with deliberation are not likely to recognize or experience dyspnea. Those who have been accustomed to move about quickly more quickly recognize shortness of breath, and mention it as such. No doubt dyspnea is usually in direct proportion to the extent of lung compromised by disease. Yet this is not always the case,

as proved even by autopsy. So far as physical signs of pulmonary change indicate, there is very often dyspnea far in excess of the lung involvement. This is strikingly illustrated in acute general miliary tuberculosis.

It should be remembered that profound anemia from any cause is associated with dyspnea upon slight provocation, even without any muscular exertion. Dyspnea due to cardiac disease will not be mistaken for a symptom of tuberculosis if examination of this organ is part of the physician's routine, as it should always be. Before excluding the heart as a cause of dyspnea, one should always consider the possibility of myocardial as well as valvular changes.

Rapid pulse is of corroborative importance in the diagnosis of pulmonary tuberculosis only when associated with other significant symptoms and signs. An adult with a pulse-rate of 95 per minute or more, when at rest on several occasions, in the absence of other known cause, should be examined for evidences of tuberculosis. Rapid pulse, of 110 per minute or more when at rest, is of more prognostic than diagnostic value. In such a case recovery from pulmonary tuberculosis is less likely than in those with a pulse-rate less than 95 per minute. One must keep in mind the ease with which the pulse of many people is markedly accelerated by merely the nervousness due to the ordeal of examination. In fact, this renders the pulse-rate of little value when only one examination is performed. The characteristically rapid pulse of Graves' disease is probably the most prominent example of rapid pulse due to disease which might be attributed to pulmonary tuberculosis. On several occasions while examining patients who had been diagnosed as having pulmonary tuberculosis and referred to me for admission to the Otisville Sanatorium I encountered cases of Graves' disease, with rapid pulse, slight cough, moderate tremor, and slight enlargement of the thyroid gland. Further investigation excluded pulmonary tuberculosis. They were uncomplicated cases of Graves' disease. One must not be deceived by the characteristic sweating experienced by those who have Graves' disease. I have also seen several cases of Graves' disease complicated by pulmonary tuberculosis.

Fever.—Although there is no infallible rule in clinical diagnosis, if a patient should have a body temperature of 99.6° F. or more every evening and 98° F. or less every morning for ten days or longer, and sepsis can be excluded, a diagnosis of tuberculous disease is fairly safe. In which case it only remains to locate the site of the disease. Clinical experience has developed the fact that in the temperate zone typhoid fever, septicemia, and tuberculosis are the only diseases which produce a continued fever for more than three weeks. So, if two of these can be excluded, the remaining one is the correct diagnosis. The paratyphoids are included under the term "typhoid" in this group, although they usually run a course of less than three weeks. A constantly subnormal temperature in the early morning is about as significant of tuberculosis as is the evening fever. Yet there are some cases of tuberculosis in which the temperature remains above normal throughout the entire twenty-four hours for many days. On the other hand, in some cases early morning subnormality is the only variation of temperature observed. This latter may occur in cases of very slight involvement with extreme general depletion, or with advanced wide-spread lesions walled off by fibroid or calcareous deposit, where the combative elements of the body are too deficient to react to the toxic substances of the disease. In some of these old cases the protective wall may be too dense to permit the toxic substances to reach the blood and produce a temperature reaction. In all of these cases the body vitality is very low and we usually obtain no reaction (negative) to tuberculin and complement fixation tests. In the advanced cases, of course, the diagnosis is usually readily made by other signs and symptoms, irrespective of the temperature.

In all cases where the diagnosis is difficult the temperature should be taken twice a day (7 to 8 A. M. and 4 to 6 P. M.) every day for seven consecutive days. The thermometer should be held under the tongue, lips closed, for three to five minutes when a rectal temperature is not taken. Although fever is a symptom of all infectious diseases, and extreme muscular exertion as well as emotional excitement may cause elevation of temperature, it is the consistent daily variation, elevated in the evening and sub-

normal in the morning for some time, which is more or less characteristic of tuberculosis. Yet there are some cases of pulmonary tuberculosis with very erratic variations of body temperature, and a smaller number in which the temperature is always normal or very nearly normal.

Pain.—Crile has said that the reason visceral lesions are frequently not associated with pain is that they do not set up any muscular protective action. The earlier theory was that sensory nerves are not distributed to those viscera in which lesions cause no pain. Whatever the reason, it is a fact that pain in the chest does not occur in pulmonary tuberculosis until the pleura is invaded by the lesion or by the inflammatory zone surrounding the lesion. Some lesions begin their clinical history with involvement of the pleura, in which case pain is an early symptom. Pleurisy, with or without the prompt production of fluid effusion, may be the first manifestation of pulmonary tuberculosis. If, as is most often the case, the mural pleura is involved, the pain is likely to be felt in the region of the nipple, along the margin of the scapular or over the apex of the lung. In rare instances pain is felt in other parts of the chest. When the diaphragmatic pleura is the site of the lesion, pain may be reflected to and felt in the abdomen or neck. If the central part of the diaphragm is involved, the pain is felt in the neck along the border of the trapezius muscle. Lesions near the outer margins of the diaphragm reflect pain to different parts of the abdomen. In this way is explained some peculiar errors of diagnosis recorded in the literature. Diagnosis of peritonitis, appendicitis, gall-stone impaction, gastroduodenitis, ulcer of the stomach or duodenum, absence of the liver, subdiaphragmatic abscess, pancreatitis, portal thrombosis, intestinal obstruction, renal colic, and diaphragmatic hernia are some of the diagnoses which have been made in cases of diaphragmatic pleurisy. On the other hand, many of these conditions have been called pleurisy because they not infrequently reflect pain to the lower chest. It is also quite common in disturbances of the liver and gall tract for the patient to feel pain in the right shoulder. These facts merely emphasize the importance of always approaching a diagnosis by comprehensive exclusion.

Lieutenant Walter L. Rathbun has called my attention to a procedure for the differential diagnosis of diaphragmatic pleurisy from intra-abdominal conditions, such as biliary or kidney stone and appendicitis, when the former is associated with pain and tenderness on pressure in abdominal regions. It seems this procedure was recently first applied in the Naval Hospital at Newport. It has been tried in only half a dozen cases, but has given consistent results in every case. The procedure is to palpate the site of abdominal pain and tenderness while the patient holds his breath. If it is due to diaphragmatic pleurisy, both pain and tenderness are absent while the patient holds his breath. The theory of reflected pain would place this observation upon a rational basis. It is certainly worth further trial and seems to promise valuable aid of the difficult cases, which have led to unnecessary laporotomy.

In central tuberculous lesions there may be no pain in the chest, even though large cavities develop. Pain, in the form of neuralgia, due to circulating toxins, either specific—from the tubercle bacillus—or from gastro-intestinal ferments, is present in some cases. These neuralgias may involve any of the sensory nerves. Intercostal neuralgia of this origin is often mistaken for pleurisy. Pleuritic pain is likely to be produced or increased by deep breathing, cough, laughing, crying, or sneezing. It is usually markedly relieved by steady compression of the affected side of the chest between the two open hands. Not so with intercostal neuralgia, which is greatly accentuated by pressure over the points where the lateral and posterior cutaneous branches of the involved nerve or nerves pierce the deep fascia. This toxic neuralgia of the cutaneous abdominal nerves might be mistaken for acute disease of abdominal viscera unless the possibility is thought of and an error avoided by proper palpation as well as consideration of other symptoms. Neuralgia of the head, face, or extremities is more likely to occur late in pulmonary tuberculosis, when the diagnosis is obvious.

In a considerable percentage of those in whom the diagnosis is relatively difficult there is a feeling of dull ache, the ache of overtired muscles in one shoulder, or along the margin of the scapula.

It is an open question whether this feeling is due to pleurisy or muscle exhaustion, so it should not be given too much weight in diagnosis.

Dryness, rawness, or pain in the larynx or throat when swallowing, especially when swallowing fluids, if persistent, should be viewed with suspicion. A laryngoscopic examination is indicated in these cases. The pain of acute lobar pneumonia is usually associated with symptoms and history which prevent error. The same may be said of angina pectoris. The pain of aneurysm and solid intrathoracic tumors is more likely to make the examiner think of pulmonary tuberculosis, but a careful analysis of history, symptoms, and physical signs, especially the latter, will prevent error. Here the *x*-ray is often of real value in diagnosis.

Cough.—Because cough is the commonest symptom of pulmonary tuberculosis, it has been the commonest cause of mistaken diagnosis of this disease. Cough is not only a symptom of disease, it is also, like sneezing, a normal involuntary protective measure. It may be availed of voluntarily, but it is always a protective act. It is peculiar insomuch as it is one of the very few symptoms of disease that cannot be hidden from one's associates. Next to pain, cough is probably the most common symptom in the category. Next to pain, it also has the most varied significance. Yet, cough is a prominent symptom in such a large percentage of all cases of pulmonary tuberculosis that it creates lay suspicion as soon as heard. There is a tendency on the part of many to attribute only certain kinds of cough to consumptive origin. "Hollow," "racking," and "loose" coughs have dreadful significance to the phthisiphobic. The fact is, no special type of cough is characteristic of consumption. In the early and even in the late stages of some cases of the disease there may be only an almost noiseless clearing of the throat. Cough is very susceptible to voluntary control or suppression in nearly all cases, even where there is considerable sputum to be ejected. This is particularly noticeable in a well-trained body of sanatorium patients. I have often made rounds at the Otisville Sanatorium, where there are nearly 600 cases of pulmonary tuber-

culosis, and not heard a single cough in the three hours of my rounds.

If a patient has had a cough continuously for six weeks or longer, and we are unable to discover another cause, it is highly suggestive of tuberculosis. The uvula, if elongated, may produce cough until it is amputated. Posterior nasal drippings or other pharyngeal irritations may be the cause. Hypostatic congestion of the larynx or bronchi must also be excluded. Cough due to acute infections or neurasthenia rarely lasts six weeks. Cough should never be considered as confirmative evidence of the presence of pulmonary tuberculosis, it is only suggestive of the possibility of the presence of this disease.

Hoarseness, when persistent, especially if associated with pain on swallowing, is sufficiently suggestive of tuberculous laryngitis to demand thorough investigation. In the absence of other and confirmatory evidence I never like to accept as final the opinion of a laryngologist who is highly specialized in tuberculosis in these cases. I find that they are inclined to attribute every partially immobilized and reddened cartilage or false cord and neighboring structure to tuberculosis. In this I do not agree with them. Many of these cases clear up in time and in such a way as to exclude the probability of tuberculosis.

Sputum, like cough, is never characteristic of pulmonary tuberculosis. There are two substances which may be found in sputum—one almost, the other quite, indicative of this disease—blood and tubercle bacilli. Nearly all persons with pulmonary tuberculosis, except those in which the lesion remains confined to the pleura, raise or have at some time raised sputum. Never is the gross character nor the amount diagnostic. A curious belief has been held by some that if sputum sinks in water, it is due to consumption; if it floats, it is not. This is, of course, mere superstition. If sputum is filled with air-bubbles it will float. If it is relatively solid it will sink, irrespective of the disease. Sputum, even from well down in the lung, may be raised without cough, especially early in the morning. When sputum of any character is raised for a month or more it should be examined bacteriologically. Large quantities of sputum, a teacupful or more in

twenty-four hours, is suggestive of bronchiectasis or large ulcerative cavity. Extremely fetid sputum is strongly suggestive of lung abscess. Slightly fetid sputum in large amount for a long time suggests bronchiectasis.

Night-sweats.—The laity and many of the medical profession consider this symptom as almost positive indication of consumption. Night-sweats frequently occur in pulmonary tuberculosis, and are usually of serious significance. They are likely to occur only in those cases where the diagnosis is otherwise not difficult. In fact, when night-sweats occur in a person who does not present the more or less characteristic temperature variations, cough, dyspnea, pains, sputum, hemorrhage, bacilli, or physical signs, the sweats are almost certainly not due to pulmonary tuberculosis.

General depletion, from prolonged anxiety, overwork, excesses (alcoholic or sexual), or digestive disturbance not infrequently produces nocturnal drenching or local perspirations during sleep.

The sweats of septic infection are likely to occur irregularly throughout the twenty-four hours. Malarial sweats bear a fixed relation to chills and fever. With the fall of all fevers, such as that of tonsillitis or grip, especially when antipyretic drugs have been administered, profuse sweating occurs.

Although some cases of tuberculosis have sweating confined to the neck and shoulders, many of these local sweats are of purely neurotic origin.

Hemorrhage (hemoptysis) needs no further emphasis to establish its place as the premier symptom of pulmonary tuberculosis. It is probably much more important at this time to give prominence to the fact that blood spit from the mouth is not a sure sign of this disease. Next to the presence of tubercle bacilli in the sputum and confirmatory physical signs in the chest, hemoptysis is the most positive evidence of pulmonary tuberculosis when some other source of the bleeding cannot be demonstrated. Yet, the rare appearance of minute particles of blood in the sputum, even though a point of bleeding cannot be seen in the mouth, throat, or nose, is not enough upon which to base a positive diagnosis of pulmonary tuberculosis. Bleeding from a gastric ulcer is often

difficult to differentiate from true hemoptysis. The patient's ability to tell whether it was vomited or raised from the lung is not always accurate. In these cases, when physical examination cannot fix the site of the lesion, there is an extreme waxy pallor following hemorrhage from a gastric ulcer, which is almost never so marked after an initial pulmonary hemorrhage. Yet, I have seen several instances where a confusion of the two conditions by experienced examiners was subsequently proved.

Before pronouncing a positive diagnosis solely upon hemoptysis, even when a teaspoonful or more of blood is raised, we should consider esophageal or laryngeal varicosities, cardiac disease, or aneurysm. Injury which does not penetrate the chest wall is not likely to cause pulmonary hemorrhage unless it be extremely severe. Some chemical vapors, such as the poison gases which recently emanated—quite appropriately—from Germany, produce bleeding from the lungs. A knowledge of the industry in which the patient is engaged prevents error of diagnosis.

Menstrual disturbances, such as prolonged intervals between the flow, scanty or suppressed menstruation, are rather common in women or girls who have pulmonary tuberculosis. For this reason pregnancy is frequently overlooked in these patients. It is difficult to believe that the reverse could occur; that an erroneous diagnosis of tuberculosis would be based upon disturbed menstruation.

Physical Signs.—Probably the most difficult rôle to fill in the examination of one suspected of having pulmonary tuberculosis is that of an honest interpreter of the physical findings. It is my impression that, as a general rule, the average well-versed general practitioner is the physician who most often fills this rôle. His special senses are just as acute, but he is not under the urgent demand for exact knowledge that faces the specialist. There are a number of cases in which positive diagnosis can be firmly established, where focalizing physical signs are vague, scanty, or absent. In this situation the specialist at times imposes upon credulity without imposing injustice upon the patient. In those cases where the diagnosis is otherwise doubtful the patient's

physician, who is under no obligation to believe that physical signs are present which his special senses cannot detect, must challenge any positive findings of a specialist, if they cannot be demonstrated to his entire satisfaction. There is not such urgency in these cases to demand prompt compliance without conviction. The specialist is quite capable of honest error and should not take offense when the patient's own physician (whose special senses are sound) is honestly unable to detect signs which the specialist believes are present. Time, with intelligent investigation, will usually decide the diagnosis. As has been often said, failure to find lesions that exist is usually due to failure to look for them. It is true that the unwilling are blind, but a patient's physician is as willing as sincerity permits. If all his faculties are sound he will see, feel, or hear any phenomenon detected by the specialist, once his attention is directed to it. If, under these circumstances, he cannot detect it, sanity demands incredulity.

Inspection, although to be applied first in the proper sequence of the four primary methods of physical exploration, is continued intelligently throughout every examination by the competent physician. It is not only the oldest method employed, it still ranks high in importance. Naturally, the growth of complexity in the application and interpretations of other more mathematically measurable measures has deprived inspection of its former prominence. Even today, however, the wise diagnostician gives much attention and heed to his eyes. "Seeing is knowing" is not a baseless platitude in medicine any more than in other physical problems, and the more a physician intelligently looks for, the more visible indications of disease he will see.

The bearing, carriage, and voice are a fair indication of the general vigor. The furtive eyes, with pin-point pupils, of a morphin habitué may keep one from attributing emaciation, dyspnea, and abnormal respiratory sounds to tuberculosis. Yet, many of these people develop pulmonary tuberculosis.

Slight goiter, exophthalmos, and tremor not infrequently establish a diagnosis at the first glance. The bronzing of Addison's disease is likely to be overlooked by indifferent inspection. Many

other visible indications of various diseases could be named. It is only necessary for the physician to keep his faculty of inspection trained and always on the alert.

The characteristic physical picture of the advanced consumptive needs no detailed description. When a thin, pale face, with marked zygomatic prominences capped with a patch of high color, deep-set steady eyes and a small neck, speaks with a high-pitched voice of little volume, further investigation rarely changes the first impression.

The dusky or cyanosed lips and extremities, as well as other evidences of dyspnea, and clubbed fingers may be due to cardiac as well as pulmonary disease.

The Chest.—Perhaps the most commonly neglected essential in physical examination of the chest is free and unrestricted access to the parts. This is naturally an error which is most often committed in the examination of women and girls. I think it is safe to say that half of the undiagnosed cases of pulmonary tuberculosis in these patients are undiscovered through unjustifiable timidity which prevents the removal of corsets and other clothing. The chest must be viewed carefully as a whole. It is by comparing the two sides that we detect asymmetry, for there is no fixed form of chest that can be called normal. Normal is a variable quality in chests as in other anatomic parts. Rickets and spinal curvature, intrathoracic growths, heart disease, past injuries, and surgical operations all produce asymmetry and deformity in the chest. Also subdiaphragmatic tumors, when large. We must exclude these causes except in those cases where tuberculosis exists with one of these conditions.

Visible cardiac action in the third left intercostal space may be due to either heart disease or tuberculosis of the left upper lobe. Localized retraction of the chest, especially of one or both supraclavicular fossæ, is usually due to localized destruction of lung tissue. However, bad posture or emaciation from other causes may be deceptive. Limited or absent expansion over these areas is usually noted in tuberculosis. Injury or tumor of the spinal cord at the level of the fifth cervical vetrebra causes entire loss of costal breathing. The entire chest is as immobile as marble,

with only abdominal breathing, in the form of paraplegia. The "ala," "flat," "narrow," and many other special forms of chest have been called characteristic of pulmonary tuberculosis, but they are only characteristic in those cases where abundance of other evidence is available.

Palpation, besides confirming deformities and peculiarities of expansion noted by inspection, measures vocal fremitus and detects enlarged lymph-nodes, which are present in the neck, axillæ, or groins in many cases of tuberculosis. Hodgkin's disease, lymphadenoma, enlarged cervical glands due to throat infections, and syphilitic adenitis must be excluded.

Vocal fremitus is of little positive value unless markedly increased, decidedly diminished, or absent. Slight changes are of no actual value. The normal variations for different chest regions must be kept in mind to avoid incorrect interpretations. Consolidation sufficient to cause marked increase of vocal fremitus is easily confirmed by auscultation. It is only increased by consolidation of lung with open bronchi. Both percussion and auscultation are necessary to interpret the significance of absence of vocal fremitus. Vocal fremitus may be absent over hydrothorax, pneumothorax, or large solid tumors. The percussion and auscultatory sounds vary greatly in these conditions.

Percussion, next to auscultation, gives us the most positive evidence in all advanced pulmonary changes. In some conditions, especially fluid accumulation, it gives more valuable information than any other method short of exploration with a cannula or needle. This is largely due to the sense of resistance felt in percussion over fluid. In the early stages of pulmonary tuberculosis, where infiltration is slight or scattered, and there is slight or no pleural thickening or fluid, percussion is of little or no value. Even in many advanced cases, cavity formation, emphysema, pleural changes, and areas of consolidation are so intricately associated percussion often gives no aid. In fact, when percussion yields definite variations from the normal the diagnosis is usually obvious.

Auscultation is, unquestionably, the method of physical exploration, in sputum negative patients, upon which suspicions

gained by other methods must stand or fall in nearly every case. It is usually by this means that we first discover signs upon which we rest a positive diagnosis. Where the symptoms have given rise to a suspicion of pulmonary tuberculosis, it is a wise procedure to always begin auscultation of the chest with examination of the heart. In this way one obviates the rather common error of attributing pulmonary signs, due to circulatory impairment, to disease of the lung. It is not uncommon for examination of the heart to be entirely forgotten once the examiner's

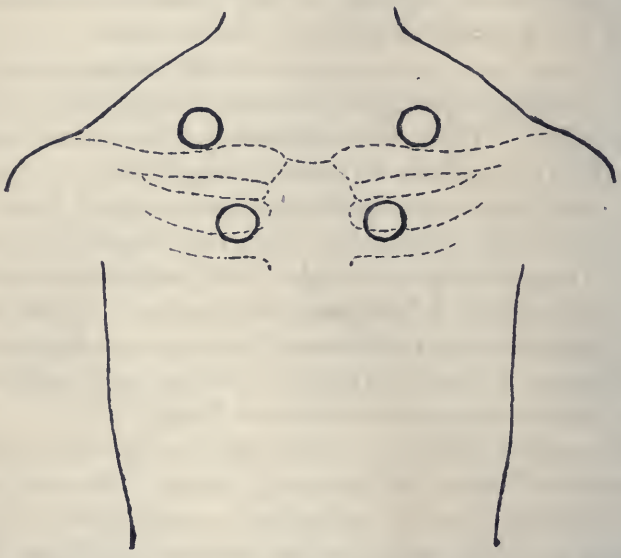

Fig. 24.—Cardinal points for auscultation, anterior surface, in the diagnosis of pulmonary tuberculosis.

interest is directed to the lung. It is, of course, necessary for the examiner not only to be familiar with, but to keep in mind, the relations of underlying anatomic structure, and the characteristics of normal auscultatory sounds peculiar to different regions on the two sides.

Although the stethoscope or the listening ear (if stethoscope is not at hand) should be applied to all parts of the surface of the chest, there are five cardinal points on each side. It is extremely rare to hear signs of pulmonary tuberculosis in a chest

when none can be detected at either of these points. As indicated in Figs. 24–27, there are two on the anterior surface, two on the posterior surface, and one lateral, in the axilla on each side.

The anterior cardinal points are just above the clavicle, and near the anterior extremity of the superior border of the second rib.

The posterior cardinal points are just above the spine of the scapular, $2\frac{1}{2}$ to 3 inches from the median line, and 1 inch from and

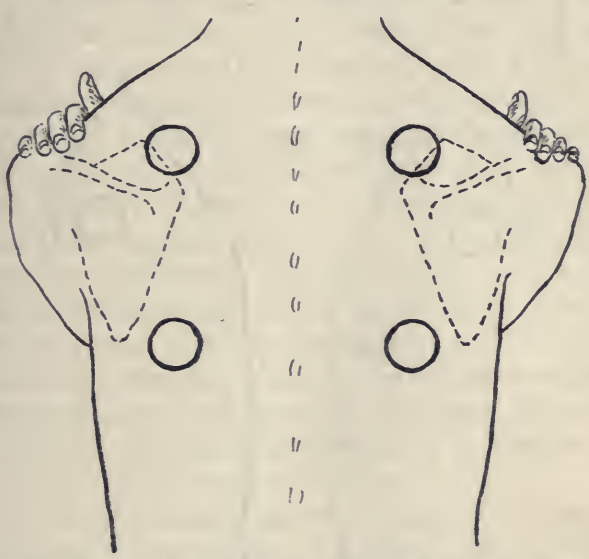

Fig. 25.—Cardinal points for auscultation, posterior surface, in the diagnosis of pulmonary tuberculosis.

to the inner side of the inferior angle of the scapula, while the patient's hand rests on the opposite shoulder.

The lateral cardinal point is high in the axilla close to the anterior axillary fold.

Much more attention is given by writers and lecturers to the pitch, duration, and intensity of auscultatory (as well as percussion) sounds in physical diagnosis than it is possible for the average medical ear to apply. Theoretically and for training the student this is both attractive and valuable. Actually the significance of a sound in physical diagnosis is nearly always known

by its quality. A subelement of quality, the distinctness with which a sound is heard, is often an aid in determining the significance. Appreciating the foregoing and with a fair knowledge of the normal and pathologic conditions that are both likely and possible, experience and good judgment will determine the degree of one's success in diagnosis.

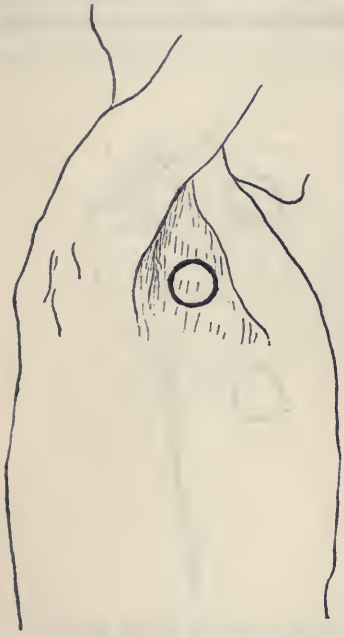

Fig. 26.—Cardinal point for auscultation, lateral surface, in the diagnosis of pulmonary tuberculosis, right side.

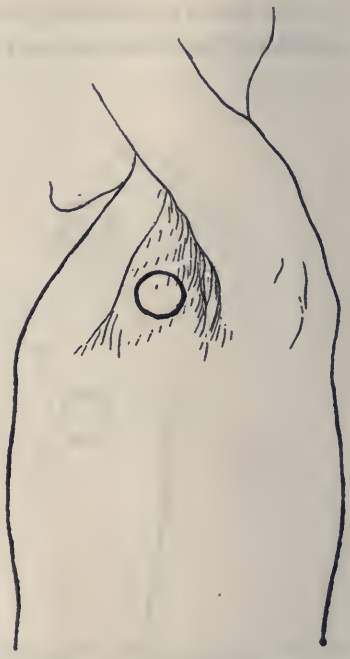

Fig. 27.—Cardinal point for auscultation, lateral surface, in the diagnosis of pulmonary tuberculosis, left side.

I do not feel that there is any occasion here to repeat the theories and familiar facts concerning the origin of such sounds as bronchovesicular and bronchial breathing, increased vocal resonance and bronchophony, egophony, and amphoric voice and breath sounds. With the exception of bronchovesicular breathing and increased vocal resonance they only occur late in pulmonary tuberculosis.

We must first understand that pulmonary tuberculosis may exist, sometimes fairly extensive, without altering appreciably the normal chest sounds. In some cases the only change is diminished intensity of the breath and voice sounds over the involvement.

In the majority of early cases, where diagnosis by physical signs is possible, but not grossly obvious, the only signs appreciable are an increase in the bronchial quality of the breath sounds, with lazy prolongation, most noticeable in the expiratory act, bronchovesicular breathing (also called "harsh," "granular," and by many other names) and a few moist râles, which may be heard constantly or only after several acts of coughing. In most of these cases an increase in vocal resonance is not appreciable, although, theoretically, it should be present. As is well known, such signs heard symmetrically on both sides are suggestive of some other infection, such as influenza or hypostatic congestion from heart or renal disease. Tuberculous lesions are nearly always either unilateral, early in the disease, or asymmetrically placed on both sides. I am rarely willing to base a diagnosis upon bronchovesicular breathing when râles are not associated with it.

When listening to the chest during and after cough one should be on his guard to avoid misinterpretation of râle-like sounds produced in the muscles or the esophagus.

x-Ray.—Except in those cases where the patient or his friends request an *x*-ray examination it is probably best to arrive at a decision without employing this agency. When the interpretations are made by a specialist who has not examined the patient confusion of opinion is very likely. In institutions, where autopsies may be performed upon those who die, *x*-ray examinations should be made, for it is only in this way that we may come to know the real value of this agency in the diagnosis of pulmonary tuberculosis. Also in those patients where symptoms or signs suggest the possibility of intrathoracic tumor or aneurysm. For determination of the extent and character of lesion and cardiac displacement, where the diagnosis is established, *x*-ray is of value.

Tuberculin.—The von Pirquet and Moro skin tests are harmless, but of little aid in the diagnosis of tuberculous disease.

Positive reactions only prove the presence of tuberculous infection and a negative reaction does not exclude it. They are of no aid in the diagnosis of pulmonary tuberculosis. The Calmette eye test has no advantage over the skin tests, and is injurious to the eye in some cases. The subcutaneous injection of a fraction of a milligram up to 10 milligrams of old tuberculin (like repeated doses of potassium iodid to produce râles, or bacilli in the sputum, where none were present) is, in my opinion, inexcusable.

After extensive and painstaking investigation with tuberculin at the Otisville Sanatorium I am convinced that, in the present state of its development, it should be confined to the field of experimental medicine.

Complement Fixation.—This test is admittedly still confined to the experimental stage.

Treatment.—It is fairly well known by now that in pulmonary tuberculosis treatment should be confined to the individual, for there is no known treatment of the disease which is of proved value. It is inevitable that in a disease which so often improves under very contradictory conditions, a great number of specific substances and measures should gain a reputation for benefiting or curing it. Air, food, and rest are essentials which are too well understood to call for discussion.

There are in many cases of pulmonary tuberculosis symptoms which must be relieved or diminished in severity. There are three major means at the disposal of the physician for relief of these symptoms which should be employed in the order named:

1. *The Patient's Mental Attitude and Will Power.*—The patient must be freed from any idea that the disease is to be certainly progressive and hopeless. He or she must know that they can, by proper acquiescence and shaping of their mode of life, almost certainly conquer the disease, living usefully and happily, as thousands have done. The will power can often control injurious cough.

2. *Physical Measures.*—Absolute rest in bed in good air will often control pain, cough, temperature, rapid pulse, and many other annoying symptoms. Strapping the chest often relieves the pain of pleurisy. A proper balance of rest, exercise, and open

air and diet usually restore the appetite for wholesome and attractive food. Stomachic tonics rarely do.

3. *Drugs.*—Only when no other available means will control symptoms should drugs be employed. When prescribed, they are, of course, given just as they are for similar symptoms in other diseases.

The *sanatorium* falls under the head of physical measures, although a properly conducted sanatorium embraces all three measures in their proper relation to each other. It is here that the maximum of good open air is obtainable. No doubt, if it were possible to treat every case of pulmonary tuberculosis in a good sanatorium and keep the patient's mental attitude as is desired throughout, this would give the best physical results. But, owing to the varied circumstances and personalities of those affected, this is quite impossible. In a large percentage of patients of moderate circumstances the sanatorium should be looked upon as an institution of learning and training for the new life they must lead. After this, by consultations, which diminish in frequency as the healing and recovery is established, their home physician acts as watchman.

The very poor, who cannot live properly for lack of money, and the erratic or unreliable should certainly go to sanatoriums.

Those in good circumstances of proper mental attitude who can be depended upon to follow advice often do very well and the disease becomes arrested without sanatorium training.

Some specialists are uncomprimising in insisting upon sanatorium treatment in every case as soon as a positive diagnosis is pronounced. Others advise treating all cases in their homes, while permitting all who are able to be up and about to continue at their regular work.

Here, as in nearly every other situation, the proper attitude lies midway between the two extremes of advice. To repeat, each case must be advised and treated individually. Knowing what we wish to accomplish, we must consider carefully the material (meaning the patient) and the measures which are best adapted to each case. Under no circumstances should the patient's mental attitude be ignored. It is of great importance in shaping

the result. Here ripe experience and very broad good judgment are essential in the physician.

Probably one of the most potent factors in the control of tuberculosis, pulmonary as well as other varieties, is the removal of infected or exposed children from injurious home conditions. Even though such removals may be only for a few months or years, it often results in the establishment of healthy resistance which prevents the development of the disease. The practitioner should be always on the alert to see that these little ones are thus protected. It may be accomplished by improved living conditions in a preventarium or in a sanatorium. Each case must decide which method should be employed.

Finally, the practitioner should never fail to report every positive diagnosis to the health authorities of his city or district.

Prognosis.—As there is need of good judgment in the diagnosis and treatment of pulmonary tuberculosis, so there is need of limitless tact and diplomacy in prognosis. Previous to twenty-five or thirty years ago, when a positive diagnosis was rare before the disease had reached what we now call the advanced stage, nearly all died in from one to three years, the average being about two years. At that time the general custom of keeping all fresh air from the patient contributed to life's brevity. Now it is not rare to see advanced cases of the disease live from three to five years or longer. Probably the average duration of life after a diagnosis of pulmonary tuberculosis is pronounced is now somewhere between five and ten years. Some will die a few months after a diagnosis is first possible, while others, in no measurable way different, will develop the chronic fibroid type of lesions and live fifteen or twenty years. The factors which determine the issue are so numerous, and many so impossible to measure, that one can rarely predict with even approximate accuracy how long any individual patient will live.

The life duration of ancestors, the personal mental attitude, the general virulence of the culture which infects the patient, its peculiar virulence to this particular individual, and his or her resistance or lack of resistance, the site of the lesion—chance mixed infections—the patient's conduct, accidental exposures,

and many other factors, some known, but more incalculable, interdict prophecy. Even when a patient's lungs appear to be riddled with large and small cavities and dyspnea is so marked that they cannot sit up in bed, when they are wasted to a mere skeleton and the pulse is rapid and thready, and one week more of life seems beyond the realm of possibility, slight improvement may ensue, giving the sufferer just strength enough to drag his mortal agony on through months of voiceless pain.

I will not repeat the well-known symptoms that usually indicate a short and unfavorable course. Every text-book on medicine recites them.

For obvious reasons, it is never wise to dim the optimistic attitude of those who are so blessed. So long as it is not permitted to interfere with proper conduct of the case, for treatment and the prevention of spread of the disease, a cheerful attitude and belief in recovery must be held out as long as possible.

CLINIC OF DR. E. LIBMAN

Mount Sinai Hospital

THE CLINICAL FEATURES OF SUBACUTE STREPTOCOCCUS (AND INFLUENZAL) ENDOCARDITIS IN THE BACTERIAL STAGE[1]

During the last few months you have had demonstrated to you a number of cases of subacute endocarditis, and today I shall summarize the symptoms of the disease in the active stage.

You know now that the cases of infection of the valves of the heart that run a subacute course have certain features that make the clinical picture quite distinctive. You also know that the disease in over 95 per cent. of the cases is due to an anhemolytic streptococcus, the so-called Streptococcus mitis, and that in most of the remaining cases the influenza bacillus is present. The clinical picture of the cases due to the influenza bacillus is practically the same as that found in the streptococcus cases, with the exception that marked clinical evidence of renal disease is more common in the former type. So that whatever I say concerning the symptomatology of the streptococcus cases will hold true for the influenzal cases.

The first author to draw prominent attention to the disease was Sir William Osler. He already referred to the condition in 1885 in the Gulstonian lectures. In this publication will be found reference to earlier observations of Wilks, Bristowe, and Coupland. Following a later paper by Osler there appeared an important contribution in England by Horder. The most important German studies are those of Lenhartz and Schotmueller, both of whom entirely ignored all earlier authors

[1] Based on demonstrations of cases in the wards of Mount Sinai Hospital in March, 1918, and on part of a presentation to the Johns Hopkins Medical Society in March, 1917.

in foreign countries. The disease had been known to Fraentzel, Litten, and von Leyden. Latour in 1912 published a monograph from which it is evident that the disease was known to French authors (Lancereaux in particular) for a very long time, the observations of Rapin dating back as far as 1871. Rapin described in some detail the tender cutaneous nodule of the disease. The views of Harbitz, of Christiania, on the pathology of various forms of endocarditis constitute a remarkable contribution to the subject. This author was quite early convinced of the possibility of spontaneous healing processes occurring in the lesions of the disease. In this country, as you are aware, very important studies have been made by Rosenow, these being mainly of a bacteriologic and immunologic nature. There are valuable contributions by Billings, Major, and others.

The disease has been given many names: chronic septic endocarditis, chronic ulcerative endocarditis, chronic infectious endocarditis, septic rheumatic endocarditis, endocarditis lenta, endocardite maligne a forme subaigue, etc., but the name by which it has been mainly known is "chronic malignant endocarditis." Until the virus of rheumatism is definitely proved to be of the nature of bacteria the term "subacute bacterial endocarditis" is a useful one, as it includes all the cases running a subacute course and of bacterial origin.

The frequency of the disease has been much underestimated. While not as common as rheumatic or syphilitic endocarditis, it is much more frequent than bacterial cases running an acute course (so-called "acute malignant endocarditis"). This holds especially true if one rules out cases of terminal bacterial endocarditis. Up to March, 1917, I had notes of 182 cases, 144 in the bacterial stage and 37 in the bacteria-free stage, and one case that had become bacteria free under observation. I have witnessed at least 65 postmortem examinations. Up to the present time, inclusive of cases of which I have not kept records, I must have seen nearly 300 cases of this supposedly unusual malady.

It is not necessary for me to describe to you today the characteristics of the anhemolytic streptococcus found in the disease.

It has been given many names, none of which is apt. It is, therefore, best to call it Streptococcus anhemolyticus or, in English, anhemolytic streptococcus. The early names were Streptococcus gracilis, Streptococcus viridans, and Streptococcus mitis. When it was found that in a number of cases the non-hemolytic cocci cultured from the blood did not produce green color in the colonies, such organisms were called Streptococcus albicans. For a time I termed the organism Streptococcus mitis.

Anhemolytic streptococci are frequently found in tooth-sockets, roots of teeth, infected gums, in all parts of the throat, in diseased accessory sinuses, in uterine infections, in the normal intestinal tract, in infections of the bronchial tree, and in local infections in any part of the body, such infections being usually not of as severe a nature as those due to hemolytic streptococci. From all such places of origin the cardiac valves may be infected, but they are rarely affected unless previously diseased.

It is important for you to know that anhemolytic streptococci may be found in the blood in cases in which there is no evidence that the patient has developed a subacute streptococcus endocarditis. In a small number of cases of undoubted rheumatic fever anhemolytic streptococci have been found in the blood. At present it is believed that there is no proof that they are more than secondary invaders. Complement-fixation tests proved negative in all such instances in which the test was tried. In subacute streptococcus endocarditis the complement-fixation test is practically always positive with the homologous organism. The cocci in the rheumatism cases, moreover, have certain peculiarities in a morphologic and biologic way.

Again, when a patient has a local infection due to non-hemolytic streptococci, bacteria may enter the blood-current and not infect the valve. Such observations have been made by Schottmueller, Rosenow, Schuerer, Thalmann, Libman and Aschner, and others. It must be evident to you that these facts are important from the standpoint of diagnosis and prognosis because they make us realize that the finding of an anhemolytic streptococcus in the blood does not of itself constitute a diagnosis of the dread disease which we are today dis-

cussing. The clinical evidence must be carefully weighed. If the organism is found over a prolonged period, and there is no active primary focus present, then one can usually be sure that one is dealing with a case of subacute streptococcus endocarditis, whether typical manifestations of the disease are present or not.

The disease occurs nearly always, as I have indicated, in people who have had a previous valvular defect. In most of these patients there is a history of rheumatism, but the organism may attack a syphilitic or atherosclerotic valve. Infection of the right side of the heart hardly ever occurs, and is then minimal. I have seen several cases in which the previous defect was a congenital one, the lesion in all the cases that I can now recall being an open ductus arteriosus. It is noteworthy that the infection occurs mostly in persons who did not know that they had a valve lesion; or knew it, but had no symptoms, or slight or moderate symptoms only. It is unusual for a patient suffering from marked so-called decompensation to develop the disease. Patients with organic tricuspid disease usually do not develop the disease. The explanation is, I believe, that such patients are earlier decompensated. I might say in passing that tricuspid disease is one of great interest, especially as regards prognosis, in cases of valvular disease, and that it needs much more study than has been devoted to it in the past.

While the infections by the streptococci may arise from any of the foci I have mentioned above, and while such foci may represent not merely the presence of the cocci, but diseased processes due to them, the infections originating the disease are usually of a type that give no, or slight, local symptoms. For that reason the onset of the disease is almost always insidious, and there is no definite history of a primary infection. The earliest symptoms of the disease not infrequently resemble those supposed to be characteristic of influenza or an ordinary "cold," and therefore we are often told that the disease began with a "cold in the head" or an attack of influenza.

The disease may occur at all ages, but is rare in childhood and in old age. Of 150 cases of my own, tabulated by Dr. Maurice Rashbaum, who has been of the greatest service in

collating the data, only 1 case occurred in a child under ten years of age, 4 between the ages of fifty and sixty, and 3 between the ages of sixty and seventy. Over one-half of all the cases occurred in patients in the second and third decades, and in these two periods the incidence was the same. The youngest case was eleven, the oldest sixty-seven, years of age. Since Dr. Rashbaum studied my cases for me I have seen a case in a child of five. Cautley describes a case in an infant. In a study of 180 cases we found 101 in males and 79 in females. Whether this predominance in males means anything or not I do not know.

THE SYMPTOMS IN GENERAL

In discussing the symptoms of the disease you will note that, apart from those due to intercurrent conditions, they are produced in the following ways: We have first the symptoms due to the original valve defect, and of that disease as influenced by the fever of the disease, the anemia, the exhaustion, and the complications. These I call cardiac or, better, myocardial symptoms. Then there are the symptoms due to the infection. These are of two kinds: first, those due to the toxemia, and, second, those due to the vegetations in the valve. Due to the toxemia we have the fever with all its manifestations, including usually a marked anemia. Due to the change in the valves we have what I have termed the endocarditic symptoms. These include all manifestations due to breaking off of larger or smaller vegetations on the valves. Such symptoms are petechiæ, tender cutaneous nodules, embolisms, embolic aneurysms, and purpura. Purpura may, however, also be produced, I believe, by the toxemia and anemia. The subject of purpura in cardiac disease of all kinds needs elucidation.

The onset of the disease, as I have said before, is usually insidious. The patient may be up and around for a long time. We usually reckon the disease as lasting from four to eighteen months, but longer and much shorter cases have been observed by other authors and by myself. The earliest symptoms are of the greatest variety. In fact, we could spend all the time

at our disposal today in going over the many modes of onset of the clinical picture. I may later do this in a brief fashion. The most common symptoms at the onset are lassitude, vague pains, loss of appetite, feverishness, chills or chilliness, vertigo, headache, cough, and, less often, cardiac symptoms. The constant symptom in all the cases is fever. Occasionally the disease is acute in onset, the first symptoms being a high temperature, accompanied or not by a chill, or an embolism of one of the organs or of one of the peripheral vessels. It is very probable that in all such cases there has been a fairly long preceding period during which the patient was suffering from the infection, and either did not feel ill or did not feel ill enough to consult a physician. I remember seeing a woman who, ten days before being seen by me, walked almost ten miles in the Catskill Mountains in company with her physician. She took sick with vague abdominal symptoms, diarrhea, and fever, one or two days later, and was brought to New York on the day before that on which I saw her. She was suspected of having an atypical typhoid infection. Because of the presence of an exquisitely tender sternum without evident cause I examined her heart with great care, and finally satisfied myself that the mitral orifice was stenosed. After a prolonged search I found one petechia. A blood-culture was ordered, and the next day an anhemolytic streptococcus was found. On the same day the patient died, with symptoms of pulmonary infarction.

The possibility of patients going around for a long time and attending to their duties and not realizing that they are sick is a very important one in connection with a part of this subject that will occupy us much in future conferences—namely, the bacteria-free stage of the disease. It explains how it is possible for us to encounter patients who have become spontaneously free of the infection and come to us only later with the after-results of the infection.

The most frequent symptoms of the disease are the following: Chills, fever, sweating, anemia, emaciation, petechiæ, purpura, cardiac symptoms, renal phenomena, tender nodes, pulmonary symptoms, tender sternum, changes in the color of the face,

splenic enlargement, gastro-intestinal symptoms, cerebral disturbances, joint pains and joint swellings, and peculiar pains in various parts of the body. Changes are found in the background of the eye in some of the cases, and these I shall briefly describe.

FEVER, CHILLS, SWEATS

The course of the fever is very variable. It is usually low at first and higher later. If one has the opportunity of observing the cases for a long period, beginning early in the disease, one often finds that the fever will at first be moderately elevated for a period of, say, a week or two, then for a few days come to a slightly lower level, then rise to a higher level than at the beginning, and after several such waves the temperature will finally reach 103° or 104° F., and have a tendency, at its highest, to remain near that level most of the time for a number of weeks. The fever is usually irregularly remittent, but at times intermittent. It is not uncommon to find little or no fever for a period of a few days or longer. Toward the end of the disease the fever is sometimes absent for two or three weeks. I have found this to have a greater tendency to occur in patients who have developed clinical evidences of renal insufficiency to such a marked extent that the diagnosis can be made from smelling the breath. Complications influence the temperature very considerably, embolisms in particular having a tendency to cause sharp rises.

An occasional chill may occur in the course of any case. A chill will often mark the occurrence of an embolism or the onset of an intercurrent disease. There are many cases in which no chills are observed at any time. On the other hand, there are cases characterized throughout by the occurrence of severe chills, sometimes two or more a day. I have been struck by the fact that cases which are characterized by the occurrence of frequent chills are often those in which the first evident symptoms of the disease are due to splenic infarction. In some cases the sudden rises and falls of temperature, with attendant chills, may be due to sharp bactericidal action of the blood-serum. Blood-culture studies should be made frequently in such cases,

before and after chills, to determine the validity of such an opinion.

As in other diseases, chills occur very often after the use of any method of intravenous therapy, salt-water infusion, or any form of transfusion. If a chill has followed any method of intravenous treatment the temperature may fall to normal for from one to several days. It is interesting in this connection to draw attention to the observation of Kinsella and Swift, that the blood often becomes bacteria free for from one to several days after such a reaction has occurred.

The chills are usually followed by profuse sweating, but sweating constitutes in itself a very common and often an early symptom. This has frequently led to an erroneous diagnosis of tuberculosis being made.

CARDIAC SYMPTOMS

Earlier I explained to you the difference between myocardial and endocarditic symptoms in cardiac disease. This differentiation, as I shall explain to you more fully in connection with cases in the bacteria-free stage, is of fundamental importance. In the bacteria-free stage one finds, on the whole, less endocarditic symptoms and more myocardial symptoms, that is, symptoms due to myocardial strain. The endocarditic symptoms I have named. The myocardial symptoms may occur in any case of disease of the heart, whether it be valvular, myocardial, or vascular in origin; in other words, whenever the heart muscle is strained. The myocardial symptoms are apt to be more marked in the bacteria-free stage than in the bacterial stage, and more marked late in the bacterial stage than early.

Dr. David MacDonald, in a splendid contribution on the etiology and the causes of cardiac insufficiency in cases of valvular disease, has listed so well the symptoms that we are wont to find when the heart muscle is weakened that I can do no better than copy his data. The myocardial symptoms are: Breathlessness (on exertion, or dyspnea, or orthopnea), edema (feet and ankles, feet and face, feet and abdomen, feet, face and abdomen, general anasarca), palpitation, bronchitis, cough with-

out expectoration, thoracic pain (precordial, right-sided, sense of constriction, angina-like), general weakness, hemoptysis, anorexia, vomiting, epigastric pain, flatulence, nausea, gastric discomfort, headache, insomnia, giddiness, fainting attacks, cold extremities, feeling of impending dissolution, throbbing under right costal margins, epistaxis, noises in the head, and failing eyesight. This list of MacDonald's lacks certain symptoms. I shall not go into a discussion of all of them now, but wish to add the following: Cyanosis, clubbing of the fingers, arhythmia, feeling of pressure and pain in the region of the liver, tenderness of the liver, evidences of insufficiency of the functions of the liver, jaundice, and pulmonary edema. The tendency toward the development of venous thromboses, especially in cases of valvular disease, has been well brought out by Dr. Welch in his learned contribution to the Jacobi Festschrift.

Any or many of these myocardial symptoms may be observed in patients suffering from subacute streptococcus endocarditis. The evidences of hepatic insufficiency are not usually present in the bacterial stage of the endocarditis cases, because, as stated above, the disease occurs less in decompensated individuals and infrequently where there is tricuspid disease present. The greatest tendency toward the development of hepatic symptoms is present when there is tricuspid disease present. The symptoms of less marked cardiac insufficiency are present in a number of cases early in the disease. But it is a remarkable fact that in many cases there are no evidences of cardiac insufficiency until late in the disease, and that they are due as much or more to the exhausted condition of the patient and to the anemia than to the changes in the heart as such. The endocarditic symptoms we will take up separately.

It is unusual for any new murmurs to develop in the course of the disease. If you look at specimens of hearts obtained from patients dying from this disease you will see why this is so. When the mitral valve is involved there is little or no tendency to ulceration, and the vegetations extend up on the wall of the auricle and involve the chordæ tendineæ. There is usually no tendency toward a blocking of the mitral orifice. When there

is aortic involvement ulceration may occur, but it is unusual. Ulceration occurs only when the vegetative process is extensive, and then any insufficiency caused by the ulceration is compensated for by the masses of vegetations. A mass of vegetations on an aortic flap may cause an increase in the loudness or roughness of a previously existing systolic murmur. At the mitral orifice previously existing systolic murmurs may increase in loudness or in area of distribution when the heart muscle becomes weakened. A systolic murmur in the pulmonary area may develop as in other cases of anemia or long-standing enfeebling disease. At postmortem examination the chordæ tendineæ are often found torn. Such torn chordæ tendineæ do not cause the auscultatory phenomena that have been ascribed to this lesion. The rapidity of the pulse depends much on the grade of severity of the fever and toxemia, and on the various complications. It may remain but little elevated for a long time. Arhythmia is remarkably infrequent.

It is very unusual to find evidences of pericarditis in cases of subacute streptococcus endocarditis. When pericarditis occurs and there is present no extensive infarction of the heart muscle, to which the pericarditis is reactive, and there is no pneumonic lesion found, and the pericarditis is not the terminal pericarditis of a chronic nephritis, one must be suspicious of a mixed infection with the virus of rheumatism.

The heart muscle, as you know, contains lesions which are called Bracht-Wachter lesions, and which are located in the muscle-fibers themselves. Up to the present time there are no reports of changes that may be found by electrocardiographic studies. That the cardiac insufficiency may be due mainly to anemia is proved by the fact that transfusion may cause a remarkable increase in cardiac power, just as transfusion does in many cases of pernicious anemia.

PULMONARY FEATURES

Cough is a very frequent symptom, even early in the disease. In some cases the patient has a severe spasmodic cough, although no gross changes may be found in the lungs. Such a cough may

be due to pulmonary congestion, for we encounter a similar cough in certain cases of mitral stenosis. I have thought that the violent cough might at times be due to irritation of the trachea at its bifurcation by the presence of enlarged tracheobronchial lymph-nodes. It is quite the rule to find these nodes (inferior intertracheobronchial group of Poirier) enlarged in cases of infection of the valves of the heart, these being the nodes to which is brought the lymph return from the heart. You would be surprised at the autopsy table to see how large these nodes may become.

There is a tendency in the disease toward the development of bronchitis, and the sputum is apt to become hemorrhagic. Other conditions that are observed are bronchopneumonia, lobular pneumonia, lobar pneumonia, infarctions, pleural effusion, pneumonia, and pulmonary edema. Dry pleurisy is uncommon. Lobar pneumonia may occur as a direct intercurrent (not uncommonly terminal) infection, or may be secondary to infarction of the lung. In the latter event the infarction is usually very extensive. While infarction of the lung is usually accompanied by hemorrhagic sputum, the latter is not always discolored. On the other hand, hemorrhagic sputum does not always signify infarction, because, just as in cases of valvular disease without fresh endocarditis, only a third or fourth of the cases with hemorrhagic expectoration present real infarctions at autopsy. Such hemorrhagic expectoration is more often due to congestion of the lung, combined or not, with a hemorrhagic tendency in general. The incidence of hemorrhagic tendency in patients with valvular disease (especially tricuspid disease) and with endocarditis has not been studied.

Infarction of the lung is not a frequent occurrence in cases of subacute endocarditis. When it does occur it is usually of the same type as is found in cases of valvular disease in which no endocarditis is present. Twice, however, I have seen infarctions in which the plugs in the vessels did not consist of ordinary thrombus material, but were made up of the same material as the vegetations in the valve. In one of the cases there was present an open foramen ovale, and in the other the

ductus arteriosus was patent, and there were extensive vegetations on the wall of the pulmonary artery which was the seat of an aneurysm.

Pleural effusions may occur secondarily to a pneumonia or an infarction, or may occur in the absence of a definite pulmonary focus. The fluid is clear, sometimes hemorrhagic. Pleurisy or pleural effusion may be caused by splenic infarction. Toward the end of the disease hydrothorax is apt to be present. This is more likely to occur if the anemia be profound. Pulmonary edema may occur in the course of the disease, but more often near the time of death.

RENAL AND VESICAL SYMPTOMS

The clinical picture presented by the kidneys in cases of subacute streptococcus endocarditis has many points of interest. Embolism of the organ, as you know, is very common in this disease. We distinguish two forms of embolism, but they frequently occur together. The first type consists of embolism of larger vessels (macroscopic embolism), and the second, of vessels in the glomeruli (microscopic embolism), the latter constituting the remarkable characteristic lesion described by Loehlein, and then studied with great care, particularly in the bacteria-free cases, by Dr. Baehr.

The symptoms of the grosser infarctions may vary in severity from a very mild pain to violent spasms of pain, usually accompanied by hematuria. The kidney or kidneys may be found enlarged. Often there is marked tenderness present. The situation of the pain is usually the lumbar region, sometimes radiating down to the external genitalia. At times the pain is felt most in the flank or in the front of the abdomen. Bladder symptoms are frequent, consisting mainly of frequency of urination, usually accompanied by pain, tenesmus, pain in the hypogastrium, and sometimes retention of urine. When the pain is severe and accompanied by rigidity in the lumbar region an incorrect diagnosis of perinephritic abscess may be made. Sometimes the pain is felt mostly just above the crest of the ilium. When the pain occurs in this position it probably means, as

Curschmann has explained in another connection, that the lumbar nerves, especially the iliohypogastric nerve, are affected by lesions involving the posterior part of the capsule of the kidney.

Vomiting is very common with renal infarctions. There are other varieties of the radiation of the pain and other accompanying symptoms that I will not now discuss. When the diagnosis is in doubt one can often make good use of the presence of Head's zones. The value for diagnosis of hyperalgesic areas in the skin was at first overestimated and is now underestimated. The method can often be used to the greatest advantage of the patient. The sensitive skin areas are particularly valuable if they occur in a patient not very sensitive to pain.

The presence of vesical symptoms has led to frequent errors in diagnosis. Cases of subacute streptococcus endocarditis have been mistaken for tuberculosis of the kidney and bladder, pyelonephritis, calculous kidney, and perinephritic abscess. In a number of instances operative procedures have been carried out, and I know of at least two cases in which a kidney was removed. If a mistaken diganosis has been made before an operation, in such a case the surgeon, if he knows any pathology, will not remove such a kidney after exposing it, because the appearance is very characteristic. There are usually infarctions present of an ochre-yellow color, and the surface of the organ shows numerous fine hemorrhages, giving the appearance of the so-called flea-bite kidney. This name, as far as I know, was first applied at Guy's Hospital.

I am reminded in this connection of a case in which the blood-cultures helped us in making positive a diagnosis of a streptococcus endocarditis, and in which later very severe renal symptoms developed and there was complete suppression of urine. *x*-Ray examination was made, and there was found an irregular very dark shadow filling out the pelvis of the kidney on the left side. We were not quite convinced that the shadow represented a calculus and did not advise operation, which was also not to be thought of because of the severity of the patient's condition. At the autopsy there were found a general miliary

tuberculosis, subacute streptococcus endocarditis, and no calculus. The shadow was due solely to the presence of blood. There was a small amount of fluid blood in the bladder.

The lesions in the glomeruli are very apt to be accompanied by the presence of erythrocytes in the urine. This finding is of some value for diagnosis. One must be careful, however, not to lay too much stress on this symptom, because, apart from other causes, it may be found in severe cases of rheumatic endocarditis. In searching for microscopic hematuria the middle part of a specimen is the most important. It is probable that gross hematuria may be produced by the glomerular infarctions as well as by the gross embolisms.

It is very common, even early in the disease, to find albumin and various forms of casts in the urine. These symptoms are apt to be more marked when there are present extensive embolisms or a glomerulonephritis, or a combination of both. As a result of the embolisms or of the glomerulonephritis, or of both, interstitial changes may occur. A real glomerulonephritis is more apt to occur in the influenzal cases. Marked evidences of renal insufficiency, however, only occasionally occur, and then, as a rule, only shortly before the patient dies. Usually the patient succumbs before the renal condition is sufficiently advanced to cause renal inadequacy. When such a condition does supervene the symptoms are the usual ones, and there is a marked reduction in or absence of phthalein excretion, and changes in the blood chemistry. In women the menses are apt to be lost in the course of the disease.

SYMPTOMS DUE TO SPLENIC CHANGES

The spleen is often enlarged and palpable and may be soft or hard. When it is very large mistakes in diagnosis are apt to be made, the patient being supposed to be suffering from splenic anemia, Banti's disease, pseudoleukemia, or some other form of splenic disease. Infarctions are very frequent, and on their supervention cause severe pain and vomiting. Such symptoms may usher in the disease. The pain at the onset of an infarction is due in part to stretching of the peritoneal covering of the viscus,

and later to perisplenitis, which may at times be detected by the presence of a friction-rub that can be palpated or auscultated.

While the pain is usually felt in the splenic area, and is then accompanied, as a rule, by marked local rigidity and tenderness, it may be felt also or only in the cardiac area, particularly in the lower part. At times there is severe pain somewhere in the region of the left shoulder. Whether there is pain in the shoulder region or not, the left trapezius muscle is usually tender if the infarction is at all severe. This symptom is brought out by squeezing the muscle, with various degrees of pressure, in the supraclavicular region.

Infarctions may be very extensive and break down and even rupture. I have seen one case in which there was extensive infarction of the spleen and secondary thrombophlebitis of the splenic vein. Large softening infarcts may give rise to wide fluctuations in temperature at a time when the patient's temperature is running a rather mild course. Although polymorphonuclear leukocytes may be present in such softened lesions, they are not abundant and true suppuration does not occur. It is a feature of the disease, known for a long time, that pus formation does not occur in any of the lesions, this phenomenon, however, being very frequent in cases of bacterial endocarditis running an acute course—the so-called acute malignant endocarditis.

Horder has given an interesting explanation of the fact that the spleen may not be felt in certain cases even when it is much enlarged. He believes that it may be due to the presence of a well-developed costosplenic ligament on which the organ rests.

GASTRO-INTESTINAL SYMPTOMS: THE LIVER; ABDOMINAL PAINS

The gastro-intestinal symptoms are conspicuous in some cases, especially in the early part of the history. There is often distress after eating, pressure in the epigastrium, lack of appetite, nausea and vomiting, or symptoms like those usually ascribed to hyperchlorhydria. These symptoms may sometimes be so pronounced that the patient is suspected of suffering from malignant disease of the stomach or a serious disease of the

intra-abdominal lymph-nodes. Whether achylia occurs I do not know, but I have seen it at least twice in cases in the bacteria-free stage. Gastro-intestinal symptoms may, of course, be produced reflexly from congestion of the liver or infarction of the spleen or kidney. There are often inexplicable pains in the epigastrium, and these may occur in a severe form early in the disease. Diarrhea is an unusual symptom.

The liver is often enlarged, due to the changes incident to toxemia and to congestion. If the enlargement is marked the organ may become tender. Occasionally the tenderness is very marked, and there is also local or general abdominal rigidity and vomiting. Under such conditions the right trapezius muscle may become tender. Jaundice is a very unusual symptom, as are also the various symptoms that occur in hepatic insufficiency.

Pains in various parts of the abdomen are quite frequent. I have already described to you some of them in discussing the symptoms produced by involvement of the larger abdominal organs. Pains may also be produced by embolic aneurysms which occur as frequently in the mesenteric vessels as in any other arteries in the body, except perhaps those of the brain. Pains without assignable cause may occur in any part of the abdomen. Horder believes that such pains may be due to small omental hemorrhages.

BLOOD CHANGES

Anemia is a very characteristic symptom of the disease. It is of the type of a secondary anemia, and often becomes quite intense as the disease goes on. I have not encountered blood findings like those seen in pernicious anemia. The hemoglobin may sink below 20 per cent. The leukocytes may be hardly increased in number or there may be a high count with a decided increase in polymorphonuclear cells. The count may be normal or below normal, with an increase in the polymorphonuclear cells or in the lymphocytes. One may find a leukocyte count of 5000 with 40 per cent. polymorphonuclears, or 3300 with 52 per cent. lymphocytes, or 9400 with 80 per cent.

polymorphonuclears. I have seen counts as high as 26,500 with 86 per cent. polymorphonuclear leukocytes, but the highest count was 48,000 with 67 per cent. This last case was the one of splenic infarction and thrombophlebitis of the splenic vein to which I have already referred.

The anemia of the disease is, I believe, due to destruction of erythrocytes by the cocci, even though they are called anhemolytic, and to changes in the bone-marrow or in its functional capacity. The cocci of the disease are called anhemolytic because, in blood-plates, there is no area of clearing about them. This, however, is not a real proof of inability to cause hemolysis. The proof of this I shall give you on another occasion.

CUTANEOUS SYMPTOMS: COLOR, PURPURA, ERYTHEMATOUS ERUPTIONS, PETECHIÆ, TENDER EMBOLIC LESIONS

The cutaneous phenomena of the disease are of great interest, and give us some of the most valuable information for the purpose of diagnosis. The color of the face often becomes pallid in the course of the disease and has a tendency to have a dirty whitish color or, more commonly, a *café au lait* color. The patient often has a tired look. In cases in the bacteria-free stage the patient may develop an intense brown pigmentation of the face which is quite characteristic. In one patient in whom we found streptococci in the blood, and thereby knew we were dealing with a case in the active stage of the disease, it was noted that the face was of the deep brown color found only in the bacteria-free stage. I was suspicious that the case might be one of recurrent infection in a bacteria-free stage, and this diagnosis was confirmed at autopsy. When at a later time we go further into the question of pigmentation of the face in cases in the bacteria-free stage I shall draw attention to the difficulties that arise because of the peculiar pigmentation of the face found in patients with tricuspid disease.

There appears rarely a curious papulo-erythematous, rather dark red eruption on the bridge of the nose and extending over both sides of the face in butterfly fashion. Patients who are treated in the cold open air are more apt to present this symp-

tom, or to present it in a marked form. The eruption is also then apt to have a tinge quite bluish in color.

Purpura is a rather infrequent symptom in the bacterial stage. Through the kindness of Dr. Fordyce I can show you today a photograph of a case with the most extensive purpura that I have ever seen in this disease. It is interesting to note that the lesions on the face are distributed very much as the papulo-erythematous eruption that I have just mentioned.

A peculiar form of lymphangitis, the so-called rheumatic lymphangitis of Wilms, has been described in one case by Steinert. I have not encountered this lesion. Erythematous rashes in the group of erythema multiforme may occasionally be seen, but I cannot recall any case with a definite erythema nodosum of the classic type.

Recently, through the kindness of Dr. Lawrason Brown, I saw a case with a mild form of the papulo-erythematous facial eruption, and lesions on the forearms resembling erythema nodosum. The lesions, however, were very small. They were not tender. Scattered over the body, especially on the abdomen, were small lesions, some almost as small as roseolæ.

One of the most interesting and important symptoms of subacute streptococcus endocarditis is the petechial eruption. I have found petechiæ present in over 80 per cent. of the cases. They may be entirely absent or few in number, or so abundant that they are found over the entire body. They are apt to come out in crops, each crop lasting several days. When they fade out they may leave a yellowish-brown stain for several days.

It is important when looking for petechiæ to examine particularly the conjuctival mucous membrane of the upper and lower lids, the supraclavicular and lateral cervical regions, the buccal mucous membrane, and the fundus of the eye. When the lesions are found in the conjunctiva, concerning the petechial nature of which one is in doubt, it is a good plan to squeeze the lid at its margins, just as one presses on the skin to determine whether a lesion is petechial or not. If the particular conjunctival lesion is a petechia, it will stand out sharply against the anemic conjunctival mucosa. In looking for petechiæ on

the buccal mucous membrane one must be careful not to mistake traumatic lesions for embolic petechiæ. One must be particularly cautious in deciding about lesions of the buccal mucosa near the labial commissures, because many people have a tendency to bite the mucous membrane there and produce small hemorrhages.

The petechiæ found in the bacterial stage are apt to be a bit lighter than those found in the bacteria-free stage. It is of great value to note the color of the petechiæ very closely because petechiæ resembling those found in this disease may be found in cases of cerebrospinal meningitis, but they are apt to have a somewhat bluish tinge. Splashes of hemorrhage in the conjunctival mucous membrane unaccompanied by general purpura are not usually found in the endocarditic cases, but are often found in epidemic cerebrospinal meningitis. Petechiæ with white centers are the most vital for diagnosis, because then one can have no doubt that the lesion is an embolic one, and not a symptom of a purpuric nature. It is especially important (and this holds especially true for conjunctival lesions) to note whether the central white part is elevated or not, because such elevation does not occur in subacute streptococcus endocarditis. Petechiæ with elevated white centers are pathognomonic of infection by staphylococci and usually by the Staphylococcus aureus. They are really miliary abscesses surrounded by a zone of hemorrhage.

Of the greatest importance are the painful or tender nodes to which particular attention has been drawn by Sir William Osler. It appears that these nodes were observed by Rapin in 1870, 1875, 1891, and 1901. Rapin states that Senhouse Kirkes, working under Virchow, in 1852–53 also called attention to these nodes. Heubner is supposed to have noted them in 1879. Little attention, however, was paid to these nodes until Sir William Osler emphasized their importance, and Parkes Weber has suggested that they be called "Osler's sign." In France this lesion is called *nodosités cutanées ephémères*. My attention was first called to these nodes as being of probable importance in this disease by Dr. Manges several years before the paper by Osler

appeared. The nodes occurred in 7 of the 10 cases reported by Osler, and in at least 50 per cent. of the cases that I have observed. The description given by Osler is as follows:

"The nodes appear at intervals as small swollen areas, some the size of a petechia and others as large as 1½ cm. in diameter. They are raised, red, with a whitish spot in the center. They may pass away in a few hours, but usually last one day or longer. The most common site is upon the tip of the finger, which may be slightly swollen. They also occur in the pads of the fingers and toes, thenar and hypothenar eminences, sides of the fingers, and the skin of the lower part of the arm. In one case they occurred in the skin of the flank. They are never hemorrhagic. Sometimes they are of a vivid pink hue with a slightly opaque center."

In my experience certain other forms of these lesions are to be seen. For instance, there may be erythematous areas without the formation of the nodule. Such an area may cover the whole pad of a toe or be pin-point in size. Some of the large areas are of a paler color, and in them can be seen darker erythematous lesions of the size of a pin-point. No matter how small the lesion is, it is always tender when recent. This usually holds true even if the patient is not sensitive to pain. Sometimes the lesions are quite bluish or purplish in color. One also encounters anemic areas in the skin; these are usually accompanied by nodule formation. Such lesions are also always tender. A whole terminal phalanx of a hand or foot may be anemic, swollen and tender, or dusky red or purplish and swollen and tender. Sometimes one sees an anemic nodule surrounded by a delicate areola of hyperemia. A week may elapse before all the tenderness has disappeared from such a lesion. Most of the lesions disappear within three or four days.

All these forms of lesions are of great diagnostic import, for, according to my experience, one finds them occurring only in the disease in question. In cases of acute bacterial endocarditis lesions may be found in the palms and soles that may be mistaken by inexperienced observers for the cutaneous phenomena of subacute endocarditis. These were described in

particular by Dr. Edward G. Janeway as "small hemorrhages in the palms and soles with slightly nodular character." The latter lesions are not tender.

VASCULAR FEATURES: EMBOLISMS, EMBOLIC ANEURYSMS, PHLEBITIS

The main clinical features, as regards the vascular system, are the embolisms and embolic aneurysms. The petechiæ, the tender cutaneous nodules, and the erythema, theoretically, should be included in a discussion of the vascular phenomena, as they are due to embolisms of capillaries and arterioles. These lesions, however, are of more interest clinically as cutaneous symptoms, and I have, therefore, grouped them under that category.

The most common location of the embolisms is in the brain. Of 50 instances of embolism tabulated by Dr. Rashbaum and myself, 27 were intracerebral. The next most common seat was the popliteal artery (10 cases), and the next the brachial artery (3 cases). Any artery in the body may be involved. I have observed embolism of the following arteries: femoral, mesenteric, temporal, hepatic, radial, ulnar, uterine, coronary, and the central artery of the retina. Embolism of the last-named artery is rare, but it may mark the clinical onset of the disease. Horder describes gastric embolisms, but I have not seen them. It would take us too far afield to review the clinical pictures produced by the embolisms in various parts of the body. You will find an exhaustive account of them in the remarkable monograph on "Embolism and Thrombosis," in the Allbutt-Rolleston System of Medicine, by Dr. Welch.

Embolic aneurysm seems to be more frequent in subacute streptococcus endocarditis than in other forms of infection. I am sorry I cannot discuss these aneurysms in detail today. The first embolic aneurysms that were described in the literature were supposed to be produced by impaction on the wall of a blood-vessel by firm calcareous material thrown off from one of the valves of the heart. Osler in 1885 described a remarkable case of infective aneurysm of the walls of the aorta which he

believed to be bacterial in origin. A few years after the paper by Osler, in 1888, Eppinger described a series of cases of embolic aneurysms which were all of bacterial origin. It was then believed that all embolic aneurysms were mycotic in nature.

In 1905 I presented evidence that makes it definite that two types of aneurysm may occur, one due to impact on the wall of a vessel by non-infective material and the other due to infection of the vessel by material containing bacteria. It has generally been considered that infection of the wall of the vessel occurred due to embolism in its lumen, but I believe the embolism occurs more often by the way of the vasa vasorum than is usually believed. While the embolism usually consists of bits or pieces of the vegetations in the valves, smaller lesions may conceivably be produced by clumps of cocci. Occasionally we can feel small nodular thickenings along a peripheral vessel. These probably represent inflammatory areas or minute embolic aneurysms. I have had no opportunity of studying these under the microscope. In the cases of endocarditis in the bacterial stage the aneurysms that occur are naturally always due to infective material. It is only in the cases in the bacteria-free stage that one encounters the non-infective embolic types of aneurysm, and this is the only condition in which it is ever found as far as I know.

The mycotic aneurysms occur particularly at the bifurcation of vessels that lie in soft tissue. The valves of the heart, especially the mitral valves and the sinuses of Valsalva, may be the site of such aneurysms. They produce symptoms by pressure on surrounding parts or by rupture with resulting hemorrhage. When this rupture occurs into the tissue of one of the limbs a false aneurysm is produced. Perforation may occur into a vein, with the production of an arteriovenous aneurysm. In the abdominal cavity they produce pain and possibly intraperitoneal hemorrhage. The symptoms produced by rupture of embolic cerebral aneurysms I shall briefly describe later.

The phenomena produced by these aneurysms may sometimes be quite extraordinary. In one case described by Horder there

were two aneurysms of the superior mesenteric artery which were so large that they could be felt as hard nodules by rectal palpation. In another case described by Hegler there was an aneurysm of one of the intrahepatic branches of the hepatic artery. This had ruptured into the liver substance and there then followed a rupture through the peritoneal coat of the liver into the peritoneal cavity. Among other examples of embolic aneurysms that I have encountered in cases of subacute streptococcus endocarditis there was a remarkable one in the femoral artery in a boy about sixteen years of age. He was admitted to the hospital with a diagnosis of osteomyelitis because of swelling in the thigh, fever, tenderness, and leukocytosis. The first impression I had of the case was that it might be a neoplasm of the left kidney with metastasis in the femur, occurring in a boy with aortic insufficiency. But when I found that he had a large spleen and was very anemic I came to the conclusion that he was probably suffering from infection of the valves of the heart, and suggested that he might have an embolic aneurysm of the femoral artery with rupture into the soft parts. At autopsy we found extensive erosion of the femur, which explained the violent pain from which he had suffered. The blood-cultures during life had remained sterile. At the postmortem examination there were characteristic lesions of subacute streptococcus endocarditis present, most of which were organizing or were completely organized. In the more recent lesions there were found, on microscopic examination, streptococci which could not be cultured. You will find a case like this described in the Quarterly Journal of Medicine by one of our former interns. It is the same case as the one about which I have told you. The interpretation given by the writer is not correct. Had I known that the material was to be used, the case would have been correctly put on record.

As regards the veins, the only lesions of interest are phlebitis and arteriovenous aneurysm. Phlebitis is an uncommon symptom. It usually occurs late, but may be the first symptom. Whether, besides being due to the causes to which it is usually ascribed, it is ever caused by metastatic infection of the wall of

the vein by the cocci of the disease I do not know. I can remember one case of arteriovenous aneurysm of the femoral artery produced in the manner just described to you.

OSSEOUS SYMPTOMS: THE TENDER STERNUM: BONE PAINS

As regards symptoms in the osseous system, the most interesting phenomena are the tenderness of the lower sternum, to which I drew attention in 1910, and the bone pains. The sternal tenderness does not occur in all cases, and is apt to be a late rather than an early symptom. It may occur in the absence of any marked anemia. In the bacteria-free stage it is a much more constant symptom. It must be remembered that there exists a number of causes for tenderness of the sternum, and I do not wish to be understood as stating that a tender sternum means that you are dealing with a case of endocarditis. But when you find it and do not readily find an explanation for it you must think of endocarditis as a possible cause. Earlier this afternoon I sketched for you a case in which this symptom led to a correct diagnosis. I might interpolate here a fact to which we will refer when discussing certain aspects of valvular disease, namely, that in tricuspid disease the sternum is often tender, and that in the presence of marked dyspnea the sternum is less apt to be sensitive.

In testing for tenderness of the sternum it is best to tap the upper sternum and then the lower with the same force so as to get the comparison. If the lower is not sensitive, one increases the force of the tapping of the upper and lower sternum. Direct pressure against the sternum is not advisable because such pressure against any bone is apt to be painful. This sternal tenderness is more significant if it occurs in a patient not very sensitive to pain. It is a comparatively simple matter to tell if a patient is sensitive to pain or not. In the majority of people pressure on the styloid process is rather painful. In some, pressure on the styloid process is exquisitely painful; in others, only slightly so, and in some there is no pain at all. It is in the latter class that the symptom of pain or tenderness is more valuable for diagnosis. I shall discuss this matter more

fully on another occasion. I would, however, suggest now that if you wish to use this test you first always press on the mastoid process for a control observation, but you must press directly against the bone and not rub the skin over the bone, as that may give you deceptive tenderness. This test for sensitiveness of patients is simple, but of the greatest value in making diagnoses as well as determining how a patient will stand operations under local anesthesia.

The sternal tenderness is probably due to active regeneration in the bone-marrow. In several fatal cases in which we could obtain material from the marrow of the long bones we have found such regeneration. Its absence cannot always be explained. In some cases there is a lack of sensitiveness on the part of the patient, and in some the lower sternum is very narrow and quite thin, and, therefore, there can be but little medullary tissue present.

Severe pains may be located in any of the bones. Horder described a case in which the most prominent symptom was in the sacrum, and another with ischialgia. Some time ago I saw a case with Dr. Louria in which the blood-culture showed an anhemolytic streptococcus and in which we believed an endocarditis was present, but in which the pain in the upper end of the femur was so severe that we considered it justifiable to make an exploratory incision. The periosteum was found slightly loosened, but there was no lesion in the bone-marrow except for some hyperemia. Lenhartz was of the belief that many of the pains in the limbs felt in the course of cases of subacute streptococcus endocarditis were located in the periosteum of various bones. Recently I saw a child that was under the care of Dr. J. Mandelbaum and Dr. Otto Hensel; the case was believed by them to be one of subacute streptococcus endocarditis, and after repeated trials an anhemolytic streptococcus was found in the blood. The child developed two kyphoses. Such a lesion I had not seen before nor have I found it in the literature. Schoene speaks of "metastases in the spleen, joints, and vertebræ," but does not give any account of the symptomatology of such vertebral changes.

CEREBRAL SYMPTOMS: PAINS

Cerebral symptoms are quite common in the course of the disease. A curious early symptom is vertigo, which has been present in a few of my cases. Such vertigo may occur on arising in the morning or after exertion. In one patient, who had fever and attacks of vertigo every morning on arising, Dr. Joseph Rosenthal of Brooklyn made the diagnosis by finding a small embolic tender nodule hidden in the web between the big toe and the second toe of the left foot. The blood-culture was then found positive on a number of occasions.

Very common symptoms are headache, irritability, and insomnia; it is not uncommon, especially toward the end of the disease, for the patient to develop delirium, stupor, or coma. There may be extensive hemorhages into the brain or into the ventricle or the subarachnoid spaces, due mainly to the rupture of embolic aneurysms. Intraventricular and subarachnoid hemorrhages produce a symptom-complex resembling a meningitis. There is severe pain in the head, stupor, coma, or occasionally convulsions, rigidity of the neck, some hyperesthesia, and Kernig's sign. If the patient becomes unconscious and regains consciousness he is apt to be more or less delirious. There may be paralyses of the extrinsic or intrinsic eye muscles. The patient need not die because of such a hemorrhage. In fact, it can occur more than once in the same patient. In a bacteria-free case I saw the patient recover from a severe hemorrhage of this kind and live for over two years more, when he died of cerebral embolism.

Lumbar puncture in such cases reveals a bloody fluid. If you are in doubt as to whether such blood admixture in the fluid is due to traumatism from inserting the needle or was present in the fluid before the puncture was made it is quite simple to arrive at the truth. As a rule, such cases are not punctured until twelve to twenty-four hours have elapsed from the time of the onset of symptoms. By that time there is a lymphocytosis in the fluid. You ought then to make a differential blood count at the time you make your puncture, and if you find a higher lymphocyte count in the bloody fluid removed

from the spinal canal than in the circulating blood, you can be sure the blood was present before you made the puncture. There are other aids for this diagnosis, but the method I have given you usually suffices.

Cerebral emoblism, as I have already told you, is of very frequent occurrence. These emboli give the usual symptoms, and the clinical picture will, of course, be dependent on the position of the embolus. In one case having marked cerebral symptoms Steinert found an aseptic polynuclear meningitis, for which no cause could be found at the postmortem examination which was performed six weeks after the meningeal symptoms had subsided. Various forms of paresis or paralysis have been described. Apart from ocular paralyses there has been described facial paralysis, auditory paralysis (increasing deafness, Schottmüller), and hypoglossus involvement causing hemiparesis and atrophy of the tongue. I have not seen chorea in any case. Once I observed a very interesting case of rheumatic fever with chorea which was followed within a few weeks by a fatal attack of subacute streptococcus endocarditis lasting several months, during which period chorea was absent. This case shows, like many others, the differences in the clinical pictures of rheumatic and subacute streptococcus endocarditis.

Pains in various parts of the body, as you have already been able to judge for yourself, occur with the greatest frequency and are due to a variety of causes. They may be due to changes in joints, bones, periosteum or attachment of muscles to periosteum, to aneurysms, to embolic nodes, and to infarcts of the kidney or the spleen. The remarkable gastric and lower abdominal pains have already been discussed. Severe epigastric pains are not at all uncommon in cases of uncomplicated mitral stenosis in young people. Epigastric pains in endocarditis cases frequently occur when there is no mitral stenosis present.

Sometimes the pains seem to be neural in origin. I have seen at least one case in which the pain was dependent upon anemia. This occurred in a woman who had a fairly well-marked form of the disease and who complained of a deep-seated pain in the right orbit. When her hemoglobin dropped as low as 39 per

cent. it was decided to perform a transfusion. Within a few days the hemoglobin had risen to over 60 per cent. and the pain in the orbit disappeared, to return several months later, when the hemoglobin again dropped to 41 per cent. This observation would lead us to believe that the old idea that there exists an anemic neuralgia is correct. Another pain that occurs in the disease and in cases that I have particularly noted, at the onset, is a severe pain in the small of the back. It is remarkable to think that a patient can be walking around with a disease that is nearly always fatal, and have no other symptom but this pain, usually mistaken for a lumbago.

There are other remarkable unexplained localizations of very severe pain. For example, in one case there was a violent tearing pain in the side of the face. In the case of a man that came from Rio de Janeiro, who was supposed to be suffering from some tropical disease, the only symptom besides fever was an excruciating pain just below Poupart's ligament on the right side. There were no objective findings. The patient presented evidence of a valvular defect and had some temperature, and as we have made it a rule to make a blood-culture in every case of valvular defect in which fever was present, and particularly if some severe pain was complained of in some part of the body, we followed the routine in this case, and streptococci were found in the blood. The patient later developed many typical symptoms of the disease and finally succumbed.

ARTHRITIC SYMPTOMS: EDEMA; GANGRENE

Swelling of joints or peri-articular swellings are not infrequent, and the patients often complain of arthritic or peri-arthritic pains. All these phenomena, however, are milder than in cases of rheumatic fever. Lenhartz has characterized many of these pains as being "more or less marked rheumatic pains located less in the joints and more in the muscular attachments nearby, or in the periosteum of the long bones." He states also that there are occasionally only very localized spots of pain that can be covered by the tips of a finger.

As a rule, the joint does not look as if it were the seat of an

active inflammation; redness over the joint is not usually found, and when it occurs it is important to ascertain if the patient is not suffering from a mixed infection with the virus of rheumatic fever. In one case in the literature the knee-joint was aspirated, and a pale cloudy fluid found, which was sterile and contained almost entirely lymphocytes.

Edema of the extremities may be slightly marked early in the disease, but is much more frequent later. It is usually due partly to cardiac weakness and partly to anemia, and is usually a soft edema. If venous thromboses are also present the edema is apt to be firmer. General edema may occur. This is more commonly due to the anemia than to nephritis. In the influenzal cases we are much more likely to have a general edema of nephritic origin. Gangrene of the extremities, rarely of other parts, may occur, due to embolism of peripheral vessels.

OCULAR CHANGES

The ocular phenomena are of considerable interest and should always be looked for when making the diagnosis. The most common finding is petechiæ in the fundus, or occasionally small hemorrhages. On one occasion, while the fundus of a case of streptococcus endocarditis was being examined by Dr. Percy Fridenberg, we had the unusual opportunity of seeing a hemorrhage occurring in the fundus of the eye. I have never seen iritis or iridocyclitis develop—a sharp contrast to the experience in cases of rheumatic and acute bacterial endocarditis.

The white or yellowish-white spots first described by von Roth, and generally known as Roth's spots, and which are not infrequent in cases of severe general infection by the ordinary pyogenic organisms, and which, therefore, are not infrequently found in the fundus in cases of acute bacterial endocarditis, are very unusual in the disease we are discussing today. Amblyopia or central scotoma may occur, due to embolism. Strabismus naturally will be found if the eye muscles are involved. Steinert described one case of irregular diffuse edema of the fundus. A very important symptom is optic neuritis. Falconer in the course of three years studied 15 cases, and found optic neuritis

in 5. In 4 of these 5 cases there were also recurrent retinal hemorrhages. The neuritis was bilateral in all the cases but one; in this case, however, there was an opacity in the other eye. In none of these cases was there visual disturbance. The condition was looked for to help establish a diagnosis of subacute streptococcus endocarditis, and in 2 cases the diagnosis was based on this finding. Falconer believes that the neuritis is toxic in origin.

MODE OF ONSET

Now that you have heard most of the symptoms of the disease described, it will probably interest you if I indicate briefly the great variety in the modes of onset in the disease. You will then appreciate how carefully you must be on the lookout for the disease, especially in every case of valvular defect in which fever is present, and in which you have no proof that the cause of the fever is elsewhere than in the cardiac valves.

1. Fever, with chilliness and sweats, and headache and drowsiness, like the onset of typhoid fever.

2. Intermittent fever and chill, resembling malaria.

3. Like influenza, with headache, general pains, malaise, weakness, and nasal symptoms.

4. Fever alone.

5. Resembling tuberculosis of the lungs, with fever, cough, loss of flesh, sweats, pain in the chest, weakness, and perhaps hemoptysis.

6. Like tonsillitis, with pain in the neck and swelling of the tonsils.

7. Simulating rheumatic fever, the joint pains constituting the most marked symptom.

8. A tender cutaneous node may be the first symptom of the disease. Occasionally such a node is incised under the mistaken diagnosis of paronychia.

9. There may be general weakness, loss of weight, pain in the limbs and abdomen, depression, irritability, and insomnia, and a diagnosis of neurasthenia may be made until the presence of fever is detected.

10. Severe pain localized somewhere in the body; for in-

stance, in the back or thighs, or inguinal region, or limbs, or abdomen, or extending from the side of the abdomen down the side of the thigh, or a tearing pain in the scalp and face, or a severe pain located at the site of the sacrosciatic notch.

11. There is a renovesical type of onset, with pain in back or hematuria and bladder symptoms.

12. Evidences of myocardial insufficiency may be the early symptoms—dyspnea, palpitation, and perhaps edema of the legs.

13. An aneurysm may be the first manifestation—I have described to you such a case.

14. Embolism in a limb, a cerebral embolism, or a closure of the central artery of the retina.

15. Occasionally a case has as its first marked symptom pain in the right hypochondrium, and local rigidity and tenderness, and the case is suspected of being one of abscess of the liver, or subphrenic abscess.

16. In one instance a phlebitis of the lower limb was the first symptom of which the patient complained.

17. Gastro-intestinal symptoms, such as vomiting, distress after eating, loss of appetite, or complaint of hyperacidity, may make the patient feel that he is not well.

18. Abdominal pains may be very marked at the onset and the clinical picture may resemble that of appendicitis. I have seen 4 patients in whom the appendix was removed because of an error in diagnosis.

19. Infarction of the spleen may cause a stormy beginning of a case.

20. Basal hemorrhage may occur early in the clinical picture and the case be mistaken for a meningitis.

21. Vertigo, either on ascending stairs or on awakening in the morning, is rarely the first complaint.

22. Occasionally the disease begins in the postpartum period. The patient is then suspected of suffering from an ordinary postpartum infection, when, in reality, she is suffering from subacute streptococcus endocarditis, and the disease was latent until the postpartum period. In this connection I must remind

you of the statement I made when we first met today, that to find an anhemolytic streptococcus in the blood-current does not make it sure that the patient has an infection of a valve. As far as the literature is concerned a not uncommon origin of such a general infection is the uterus. It is, therefore, exceedingly important in cases in which the uterus is apparently the cause of an infection to determine whether there is a general infection from the uterus without infection of the valve, or whether the patient is suffering from a previously undiscovered subacute streptococcus endocarditis of which the origin is not in the uterus. Help could be obtained by a careful scrutiny of the history, by the examination of the uterine secretions, and by a search for the symptoms that are rather characteristic of infection of the valves by anhemolytic streptococci (especially tender nodes).

MANNER OF TERMINATION OF THE DISEASE

Subacute streptococcus endocarditis is a disease that is almost uniformly fatal. In the last few years I have seen four recoveries in definite cases, all with positive blood-cultures. Several times I have seen the blood-cultures become negative, but these patients all died of the results of the infection. Death may be caused in a variety of ways. A frequent cause of the fatal outcome is cardiac insufficiency from exhaustion, generally with pulmonary edema. Cerebral symptoms due to embolism or cerebral hemorrhage are quite often the final manifestations. Other causes of death are embolisms, pulmonary infarction, uremia, progressive anemia, and renal insufficiency. In a certain number of cases an intercurrent lobar pneumonia cuts short a case which looked as if it would last for some time still. Occasionally a miliary tuberculosis of the lung or a general miliary tuberculosis cuts the disease short. Horder believes that the fatal termination may be due to rupture of an aneurysm of a valve, or perforation of the ventricular or auricular symptom. I have never seen perforations of these septa in subacute cases, nor are there any records of such a lesion in the literature. As regards aneurysms of valves, I have never seen death due to a

rupture of them. Aneurysms of the sinuses of Valsalva might cause death by rupture, particularly into the pericardium.

ASSOCIATION WITH OTHER DISEASES. SURGICAL RELATIONSHIPS. THE DIAGNOSTIC SYMPTOMS

As you will have noted, the disease is not infrequently associated with other diseases, and there are aspects of the disease that have an important surgical relationship. The diseases with which we have found the condition associated are mainly tuberculosis and lobar pneumonia. The former association is much the more infrequent. That the disease has important relationship to rheumatic fever is evident from the fact that while valvular defects due to lues or to atherosclerosis may become infected, it is particularly the valvular defect due to the rheumatic virus that is the main seat of predilection. The frequency of luetic compared to that of rheumatic valvular disease is much greater than the relative frequency of subacute streptococcus endocarditis in the two types of valvular defect. Apart from this consideration, mixed infections may occur, that is, the virus of rheumatism or the syphilitic virus may be active at a time when the valvular defect due to an old obsolescent infection is infected by the streptococci. How often such active infections coexist I do not know. In one case at postmortem examination we found the characteristic lesions of a recent rheumatic endocarditis on the mitral valve and in the heart muscle, and the evidences of subacute streptococcus endocarditis on the aortic valve. In cases of streptococcus endocarditis occurring in luetic valves I have thus far only found symptoms of the lues (apart from those due to the aortitis or aortic insufficiency) in 2 cases. In one, cerebrospinal lues was manifest; in the other, paresis.

The surgical relationships of the disease have been briefly indicated to you. I shall not discuss them any further, but shall mention the main conditions that may be thought to be present and be in need of surgical relief. These are abscess of the spleen, subphrenic abscess, liver abscess, appendicitis, pyelonephritis, renal calculus, tuberculosis of the bladder, perineph-

ritic abscess, and osteomyelitis. That the gangrene due to an embolism in the course of the disease or that an aneurysm may need the advice and help of a surgeon is self-evident.

A few years ago I had the opportunity of seeing a patient who was supposed to be suffering from anemia due to bleeding from fibromyomata of the uterus, and a systolic murmur found at the apex was supposed to be anemic in origin. As the patient had not bled for several months before the time that I saw her, and was complaining of pain in the small of the back, it was suspected the fibromyoma might have undegone malignant change, and I was asked to give an opinion on this point. On examining the heart I could not be sure whether the murmur which I heard indicated an organic insufficiency or not, but I rather felt that there was an organic mitral insufficiency present. I examined the patient very carefully, and near the tip of one finger I found a small red tender lesion that I considered to belong in the group of cutaneous lesions characteristic of the endocarditic cases. The patient insisted that the lesion was produced by the prick of a sewing needle. A blood-culture made on the following day revealed an anhemolytic streptococcus, and a few days later the patient's body was almost covered by petechiæ.

We will not have time today to go further into this subject or to take up the extensive question of differential diagnosis. I should like to have taken up with you the differentiation from rheumatic endocarditis as far as our present knowledge allows. The diagnosis as between the bacterial and bacteria-free stages may need careful study in those cases in the active stage which are not very marked and in which blood-cultures remain negative for a time or permanently, although bacteria are plentiful in the valve—in other words, in cases in which we fail to cultivate organisms that are present in the blood. It will be unwise, however, to take up this question until you have had demonstrated to you cases in the bacteria-free stage.

You may have gained the impression from the clinical picture as I have unfolded it to you that every case has a great variety of symptoms and of what I might call clinical upsets.

Many cases have the general toxemic phenomena alone for quite long periods along with lesser marked endocarditic or myocardial symptoms. But in any case, marked endocarditic symptoms may complicate the clinical picture at any time. Before closing I should like to again mention the symptoms that are the most important from a diagnostic standpoint. These are: fever, petechiæ, tender cutaneous erythema or nodes, anemia, splenic infarction, renal symptoms (especially gross or microscopic hematuria), severe pains, change in the color of the face, marked sternal tenderness, and emaciation. Blood-cultures should always be made in all cases of fever if the cause is not apparent. This is especially true if a valvular defect is present. Details of the methods of making such cultures do not form part of our topic today. I would, however, emphasize the following points: More than one blood-culture should be made if the earlier cultures are negative in results and the case is not clinically cleared up; the cultures should be made in optimum media, and all cultures should be observed for at least eight days. Blood-cultures are of no greater value in any condition than they are in the diagnosis of the disease the remarkable clinical features of which have today engrossed us.

CLINIC OF DR. THOMAS F. REILLY

FORDHAM HOSPITAL

THE MINOR AND MISLEADING EARLY SYMPTOMS OF DISEASE OF THE HEART AND CIRCULATION

PATIENT H. S., thirty-eight years of age (male), has suffered from weakness for the past year. In the past two months he has had cough and expectoration. During the past six months has averaged four night-sweats each month; has lost about 6 pounds in weight; his appetite and digestion are good; he has trouble in getting to sleep, but after that sleeps well; frequently during the day he is drowsy and sleepy; after the night-sweats he feels very much depressed in the morning. These sweats occur early in the morning and are most marked around the neck and limbs; chief complaints: weakness, cough and expectoration, and night-sweats.

The history thus far obtained sounds like a picture of what disease?

FIRST STUDENT: Pulmonary tuberculosis.

DR. REILLY: Now we will go on to the physical examination: He is a short, stocky man, well developed, no defects in the head or face; pulse is 80, regular, the vessel wall feels hard and is not easily compressed; the blood-pressure is 220–125; rectal temperature $98\frac{6}{10}°$ F.; respiration 20; no defects noted in the lungs, not even a single râle can be heard; the heart presents a systolic murmur at the apex and a diastolic murmur at the base; the blood is normal; negative Wassermann.

Urine: Specific gravity, 1010; trace of albumin; numerous hyaline and granular casts.

The *x*-ray shows the lungs to be absolutely normal and the heart enlarged to the left.

Closer questioning now shows that he gets up at night to pass urine on an average of three times. He states that his wife complains that his breath is offensive most of the time. He has had bad taste in the mouth on arising more or less continuously for the past four months. It passes off after breakfast. Continued observation has shown that his temperature never goes above 99° F. in the rectum. Many examinations fail to show T. B. in the sputa. After he had presented himself he was enjoined to rest for three hours daily; given kali iodid, 4 grains, and sodium bromid, 20 grains, three times a day to lessen the nervous irritability. The blood-pressure came down to 190 and remained there; meanwhile the sweats disappeared, cough ceased; bad breath and bad taste were not noticeable, and he felt well. Since then whenever he has had a hard day at business, almost invariably he has a sweat at night, and for a day or two after has a bad taste. This is one group of cases that are frequently referred to a sanatorium or a country hotel because of supposed T. B. They go, and the rest and change, freedom from human care and worry lower the abnormal high blood-pressure to what is normal for that individual at that time, and lessen the concomitant symptoms.

On closer examination we see that this patient is suffering from cardiovascular renal disease, but the history is so strongly suggestive that the diagnosis of T. B. is very tempting. The night-sweats are particularly apt to lead one astray.

The recognition of disease is much the same as the recognition of a candidate for university honors. There must be two or three major and one minor requisite or one major and many minors. In medicine very frequently we have one major symptom and a whole group of minor symptoms that are just as valuable in aiding us to arrive at a diagnosis as would be the presence of several majors. No special skill is ordinarily necessary to detect major symptoms and signs; they write the diagnosis themselves, but the great fun and pleasure in medicine is the seeking out and the proper evaluation of the minor symptoms and signs. These minor symptoms constitute the early vanguard of disease and go stalking up and down in front of us constantly without recognition. As a matter of fact the profession does not need so much to be

shown new signs and symptoms of disease, as the repetition and reminding them of the well-known signs and the evaluation of these minor symptoms of every-day life.

This is particularly true in such a system disease as cardio-vascular renal disease. Among the common minor symptoms of this disease may be mentioned: Bad odor of the breath, more or less constantly present; bad taste in the mouth, particularly in the morning on arising; a dull suboccipital headache; an increase in the saliva; sleeplessness at night and drowsiness during the day, and weakness. Night-sweats are not so common, and because of their common association with T. B. are apt to lead us astray.

Sweating is one of the means of elimination in the body just as the urine and feces are. In some people the excess of poison which cannot be handled by the bowel and urine is eliminated by sweating or by the breath, and anything that interferes with the bowel or kidney elimination is apt to throw the burden on either of the other two. Sweating is, however, by no means always an eliminative process. In acute diseases the sweating of elimination is fairly common both day and night.

Here, for the most part, there is little difficulty in the diagnosis; the day- and night-sweats of acute rheumatic fever, malaria, miliary fever, and sometimes of enteric fever are matters of every-day observation. The same thing happens to a less degree in the night-sweats of pyemia or pus collections. The night-sweats at the back of the head is such a common early symptom of rickets that it is almost diagnostic of the disease. Likewise the sweat that occurs with crises, collapse, antemortem sweats, coughing, and dyspnea are matters of daily observation.

The sweating of Graves' disease is not usually severe until the disease is self-evident. Here the frequent coexistence of T. B. with Graves' disease must be kept in mind.

In the last analysis the ultimate cause of most pathologic sweating, either day or night, is a toxic action on the sympathetic nervous system. The sweating of anger, rage, or that which follows section of the sympathetic are instances that demonstrate this. Occasionally the ultimate cause is due to an action on the greater vagus. In practice one meets with night-

sweats where the cause is not always clear at first sight in three types of cases:

1. Hidden tuberculosis.

2. A group of patients who present a syndrome mostly simulating the ordinary picture of neurasthenia, but differ in that they are more excitable; quicker in their actions than the ordinary neurasthenic. Frequently there is a previous history of night and day work, particularly mental in character. Generally it is possible to find a basic cause for this syndrome, and not a few of them have one or more major symptoms of *hyperthyroidism.*

3. Cases of cardiorenal disease.

The diagnosis of the first group can commonly be made, provided a good history is taken and sufficient careful thermometric observations are employed. Indeed, any patient who has continued rise in temperature, lasting a month or more, with night-sweats and without any evident focal cause must be considered tubercular until proved otherwise. Here the night-sweats occur usually on consecutive nights.

The second group presents no elevation of temperature; are apparently well in every other respect, particularly as far as the organs are concerned. In these cases the sweats often have continued for months at a time without any evident bad effect. They react very well to sedatives and a few large doses of atropin.

In the cardiorenal cases the sweating only appears after some physical or mental stress which puts an added load on the kidney, thus compelling the skin to act vicariously. A nose cold, a digestive attack, or a long day's work are sufficient sometimes to cause a series of night-sweats. This patient is very well when he works seven hours a day, but if he does more work than that, particularly if he works in the evening, the night-sweat occurs. His business demands overwork on Thursday, and on that night he usually has a sweat. In these patients the sweating is not severe and is, for the most part, confined to the neck and limbs. It is very rare to meet with the drenching sweats of T. B. or of pyemia.

In the morning, however, the patient feels depressed and wakes just as though he had gone through some psychic shock. After a meal this passes off.

The treatment may be summed up:

1. In *rest,* both mental and physical.

2. The use of sedatives, as 20 grains of bromids three times each day, sometimes combined with 5 grains of chloral.

In stubborn cases: Atropin, gr. $\frac{1}{100}$ at bed-time, is usually successful, but is not generally employed because of the disagreeable after-effects.

Bathing of the body with vinegar and water (1 to 8 parts) is a home remedy; often efficacious.

It will be seen that the course as well as the treatment of night-sweats in this group is much like that of the treatment of hyperthyroidism, and there is much evidence going to prove that they are closely related. Many of these patients have an abnormally wide ocular slit, have fine tremors, blush readily, and have other minor symptoms of dysthyroidism.

Bad Breath.—When this occurs as a more or less constant phenomenon the individual grows accustomed to its presence, and, aside from his occasional noticing that people withdraw from the immediate radius of his face, no special attention is paid to it, and unless questioned directly he will not vouchsafe the information that it is present. It is commonly believed that bad breath is generally due to bad teeth, and all sorts of odorous tooth pastes are employed to nullify the odor. They do this for half an hour or more, but I believe the teeth, even though they look the part, are seldom the cause of bad breath.

By smelling the breath as it comes from the mouth with the nostrils closed one can at least rule out *sinus disease.* If the mouth be now closed and the breath coming from the nostrils is *still* foul, then the cause is likely to be below the throat.

In the course of pulmonary suppuration of any kind the breath is commonly very disagreeable.

Acute or chronic sinus disease is perhaps the most common cause of constant bad breath.

Sometimes tonsils whose crypts are filled with cheesy masses cause periodic spells of bad breath of which the patient is entirely unconscious. Chronic constipation or a septic gall-bladder often

causes it. There are numerous other causes, but they are generally evident on inspection.

It is a fairly common symptom in the early stages of chronic renal disease before the onset of major symptoms.

Bad breath is such a common every-day complaint that seldom is any attention paid to it. It occurs occasionally in everyone, especially on the day following a heavy meal or after the ingestion of certain foods. It is here an excretory function; is relieved by starvation or a purgative, and is commonly regarded as an evidence of gluttony, and thus dismissed with a smile.

In some women it occurs during the menstrual molimen, and is here also an evidence of excretion.

In the presence of advanced chronic uremia it is almost always present. It is quite impossible to describe the odor except that in the late stages it may be described as uriniferous.

In this patient it was present constantly for the past four months, but he noticed (or rather his wife noticed) it for weeks at a time previously, and then it disappeared. His wife describes it as a heavy breath. Finally, it may be stated that the presence of bad breath more or less constantly present without manifest disease of the air-passages warrants the search for a constitutional cause to find out why nature is excreting foreign substances through the air-passages, and of these constitutional causes *renal disease* is a very prominent one.

Bad Taste.—Closely associated with bad breath is the question of sensation of bad taste in the mouth, particularly on arising in the morning. The complaint of occasional bad taste is such a common one after an indigestible meal that people are loath to complain of it. It is, like bad breath, commonly relieved by fasting and a cathartic, but when it becomes a more or less constant fixture one must regard it seriously. Here, again, I believe the teeth are not often to blame. Roughly speaking, the laity are apt to blame the digestive tract as a cause of bad taste, whereas the profession is apt to charge it to the teeth. After the use of a tooth-wash undoubtedly the taste is temporarily relieved or another substituted for it, but the effect does not last more than an hour or so. Like bad breath, sinus disease, cryptic

tonsils, and pulmonary suppuration are occasional causes of bad taste, but in each of these the cause is self-evident and is easily explained, but when bad taste is frequently present in the absence of manifest local disease to explain it one must look for a systemic cause.

Of these systemic causes, none is more common nor persistent than diseases of the blood-vessels or kidney. The taste is commonly described as an acid one, and is present in the morning on arising. It usually disappears during the day—once present, it is seldom absent for any interval. Sometimes it is described as a bitter taste, like that of black coffee. It is present as an early symptom in about half of the cases of chronic renal disease. It closely resembles and keeps pace with the suboccipital headache so characteristic of early nephritis. Very often it is increased by the ingestion of large quantities of proteins, particularly meat.

In this patient it is not constantly present, and bears a close relationship to his improvement or regression, as the case may be.

Drowsiness during the day is another symptom which is commonly ascribed to laziness, digestive troubles, etc. Most of the patients with renal disease, it is true, do not sleep well at night, and this would seem at first sight to account for the drowsiness during the day, but drowsiness during the day is frequently present in those who do sleep at night. One might theorize as to the cause of this drowsiness, but the fact remains that it is a fairly common early symptom in chronic vascular renal disease.

In this patient it is not a marked symptom, although at times it is annoying.

There is little to do for it from a medical standpoint.

Weakness is such a common complaint, especially among women, that it has little diagnostic import when considered alone as a presenting symptom. When it is severe, there are always other concomitant symptoms that should lead us to a correct diagnosis. Weakness in men usually means a serious lesion somewhere in the body. The most common errors arise in not seeing the exophthalmic goiter, anemia, primary or secondary, diabetes, tuberculosis, or nephritis that is present behind the screen. In women it is so commonly associated with the meno-

pause and the psychasthenias from whatever cause, that in the absence of manifest organic disease it spells bromids. Incidentally it may be remarked that one of the most common therapeutic errors of medicine is the current use of strychnin in such cases. Weakness is almost always present to some degree in the early stages of circulatory disease, whether it be cardiovascular or renal. Usually the patient must be questioned as to its presence, because it does not become manifest or troublesome until later. It must not be confused with dyspnea. The patient is simply more exhausted than formerly at the end of the day. He cannot do the work that he did some months previously. It is a valuable corroborative symptom. Once present, it seldom entirely disappears, but, on the other hand, is usually progressive. This is especially true in vascular and renal disease.

In this patient weakness is thus far not a prominent symptom, but on questioning him one finds that he is not able to accomplish his former daily quota of work because he is so easily tired. Prolonged rest always temporarily relieves this symptom.

The second patient is a young lady, twenty-eight years of age, the family history is entirely negative except that both mother and grandmother suffered from frequent attacks of "*rheumatic fever.*" Her own past history shows that she has never had any severe illness or accident. Six months ago she began to notice slight *dyspnea* and *husky voice.* At this time she was suffering from a severe attack of *bronchitis*—a disease which she had from time to time since infancy—cough was frequent with much expectoration, and at times blood streaked. Since then the dyspnea and husky voice have been marked at intervals. Three months ago during a coughing spell she expectorated a teacupful of blood. Since then on one or two occasions after running upstairs she has raised a teaspoonful of blood. After the hemorrhage she feels better. She has lost 7 pounds in weight in the past six months. When she has attacks of bronchitis there are slight rises in temperature, 101° F. for three or four days; otherwise no fever is present. The chief complaints are weakness, dyspnea, hoarseness, cough, expectoration, and hemoptysis.

Thus far we have a fairly clear history of *tuberculosis of the lungs*.

The physical examination reveals a florid individual; head normal. In the upper jaw there are two large central incisors, about twice the size of the other teeth—tombstones.

The presence of these large teeth often suggests that the person is susceptible to the rheumatic micro-organism, the net result of this being:

1. Rheumatic fever.
2. Endocarditis.
3. Finally death and tombstones.

This does not mean that everyone who has abnormally large upper central incisors will run that course, but from clinical experience it is always suggestive of a person likely to be attacked by rheumatic fever, and warrants a close inspection of the heart in such people.

The lungs are negative except for a few râles in the left posterior portion of the chest below the angle of the scapula. The pulse is regular, small, compressible; vessel walls not thickened; frequency 72; temperature 98° F.; respiration 20; the sputa examinations made on several occasions were negative for T. B.

Heart.—Presystolic murmur at the apex; slapping first sound; accentuated second pulmonic and a thrill; the apex in the fifth space within the nipple line.

The *x*-ray examination shows the lungs to be entirely clear; the heart oval in shape, enlarged to the right.

The physical examination proves that we are dealing with a case of *mitral disease* (stenosis), and this will account for all of the symptoms.

STUDENT: Can we not have also pulmonary tuberculosis present in this patient?

DR. REILLY: Of course this is always possible, *there is no No or Never in medicine*, but the absence of a slight constant elevation of temperature; no increase in the pulse-rate, and finally no T. B. after many examinations at least prevents a positive diagnosis of T. B. Furthermore, active T. B. and mitral stenosis are not commonly associated—one reason being the damming back of

blood into the lungs that makes a poor culture-media because of the congestion.

Clinical experience shows that there is some antagonism existing between true rheumatic fever and active tuberculosis, and while this is not an absolute antagonism, it is at least the rule. In this patient it is the pulmonary hemorrhage, hoarseness, and cough which is so likely to lead one astray, particularly during the short period wherein the temperature is slightly elevated.

The most common cause of hemoptysis is undoubtedly pulmonary tuberculosis, and it is responsible for approximately 95 per cent. of all hemoptysis met with in practice.

Mitral stenosis is the next most frequent cause, and represents about 3 per cent. of the cases.

Commonly in T. B. the hemorrhage comes on spontaneously. In mitral stenosis it usually comes on after severe coughing or exertion, and once the hemorrhage occurs, it frequently repeats on strenuous exertion.

In T. B. this is not the rule, but the sputa is streaked for a day or two following the hemorrhage.

When mitral stenosis causes hemorrhage there is not much difficulty in determining the presence of valvular disease.

In T. B. the patient is either greatly frightened at the presence of blood or is utterly callous as to its import, but he always feels weaker as a result of the hemorrhage.

In cardiac disease, on the other hand, the patient almost always feels better and is not so apt to be terrified by the presence of the blood.

SECOND STUDENT: What is the cause of the mitral stenosis?

DR. REILLY: This patient is quite positive that she has never had, to her recollection, either rheumatism, tonsillitis, or scarlet fever, the common causes of mitral stenosis. However, when we go back over the family history we find that her mother and grandmother suffered from rheumatic fever—this was the source of infection. The attack doubtless occurred in early infancy and did not attract attention. The infant cannot explain that it has so-called "growing pains."

In infancy and childhood the joints are not swollen. As a

rule there is present an elevation of temperature for a few days, a red throat, and endocarditis, the physical signs of which may not be evident until the doctor has ceased his visits, if he is called for the supposed "intestinal toxemia."

Rheumatic fever is just as contagious to young children as is *tuberculosis*. In the presence of an endocarditis in a child one can always find the history that someone else in that house had rheumatic fever or its direct descendant (*i. e.*, mitral disease), whether it be the parent, nurse, or old grandmother who fondles the child.

Heart disease, as such, is not inherited, but the early infection by rheumatic organism present in such patients is equivalent to the contraction of endocarditis.

Hoarseness is sometimes a symptom of mitral stenosis. It is then due to paresis or paralysis of the recurrent laryngeal nerve. This occurs because the nerve on the left side is squeezed between the left pulmonary artery and the aorta; a neuritis ensues, and is responsible for the paretic cord. In this case the hoarseness is usually associated with a tracheobronchitis, which, while it lasts longer than is usual, recovery of the voice ensues upon the resolution of the bronchitis, so that it cannot be considered as being due to recurrent nerve neuritis.

In this individual case rest in bed for two weeks and digitalis in small doses will affect a cure for the time being. The chief aim of treatment is the prevention of fresh attacks, proper occupation, no strenuous exercise (as dancing, etc.), avoidance of acute infections, such as cold in the head, etc., and, above all, eight hours of sleep each night. She may go on for a year or more without future attacks, but almost certainly future attacks will recur.

CLINIC OF DR. R. G. SNYDER

City Hospital

A DISCUSSION OF 3 UNUSUAL CASES OF ANEURYSM OF THORACIC AORTA, WITH AN ILLUSTRATED REPORT OF THE SUBSEQUENT AUTOPSY FINDINGS

CASE I

Gentlemen: Our first case is a middle-aged man, who was admitted to the City Hospital two weeks ago complaining of

Fig. 28.—Showing position of aneurysm and marked swelling of both arms.

sudden swelling of the upper half of his body (Fig. 28). This condition is associated with a slight amount of cyanosis and a

tendency to become dyspneic on slight exertion. He feels weak and often suffers from a dull pain in his chest.

The patient was a sailor until five years ago. Since that date he has been working in a wagon factory. He denies having had syphilis, but admits that his wife has had two miscarriages since the birth of the last child. The present illness started six months ago as a sudden sharp pain in his left chest. It came on while he was attempting to lift a heavy block of wood. During the following two weeks he was troubled so much with precordial pain and dyspnea that he was obliged to remain away from work. His condition gradually improved, but he did not feel strong enough to resume his former work, so he was given the position of night watchman.

On the day before his admission to the hospital he had a violent quarrel with his wife. At the height of the quarrel he experienced a sudden sharp pain in his left chest, followed by a sensation of suffocation. At the same time the members of his family noticed that his face, arms, and neck had become very dark in color. During the night he had great difficulty in breathing. He was admitted to the ward the following morning in practically the same condition as you see him, except that his face and trunk were more swollen at that time.

On physical examination one is immediately struck with the appearance of the patient, who shows an edema of the upper half of the body. The patient sits up in bed supported by four pillows, and says that he is unable to lie down for fear of smothering. His pupils are small, equal, and do not react to light and accommodation. The apex-beat is not visible or palpable. No abnormal pulsations are visible. Percussion showed cardiac and aortic outline as seen in the photograph of the patient. The radial pulse-rates are 110, regular, and they are approximately normal in character. A definite tracheal tug is present. Over the aortic area there is a loud systolic murmur, which is transmitted to the vessels of the neck. In addition to this there is a second murmur which is difficult to describe. This particular murmur has been the subject of a great deal of discussion among the various attending physicians and the interns of the hospital.

Some of the men believe it to be a very long diastolic murmur. They think that they can detect a short interval between its termination and the beginning of the systolic murmur already described. Others believe it to be one continuous murmur, with systolic exacerbation at the aortic area. The systolic part of this murmur is accompanied by a pronounced rough vibratory thrill which is palpable over the upper part of the sternum. The thrill and murmur could be heard and felt in the vessels of the neck on both sides when he entered the hospital. At present these can no longer be detected on the left side of the neck, and it should be noted that the edema and cyanosis are now more noticeable on the left arm. The aortic second sound is present, but somewhat diminished in character. Wassermann reaction is positive, and temperature, respiration, and lung signs are approximately normal.

Discussion.—Mr. A., in your opinion what are the most probable possibilities in this case?

ANSWER: 1. Aneurysm of the ascending portion of the aorta plus pressure on the superior vena cava.

2. Aneurysm involving the ascending portion of the aorta plus perforation into the superior vena cava.

3. Rupture or tearing of the aortic cusp.

QUESTION: Mr. B., please give us the evidence for and against the diagnosis of an aortic arch aneurysm plus pressure on the superior vena cava.

ANSWER: The percussion outline, the tracheal tug, the constant cough and difficulty in swallowing, with a suspicious syphilitic history (stiff pupils in a sailor, whose wife had had two successive miscarriages after the birth of healthy children), and positive Wassermann reaction all point very strongly toward the diagnosis of an aneurysm involving the first and second portions of the aorta. If this murmur is a double aortic murmur it would agree very nicely with the diagnosis of an aneurysm of the first portion of the arch, as these murmurs are usually associated with a widening of the aortic ring and a resulting aortic regurgitation. We may assume that the first sudden pain, following the lifting of a heavy weight, was coincident with the original break in a dis-

eased aortic wall, and caused the beginning of the aneurysm. To explain on this contention the subsequent cyanosis and edema coming on suddenly six months later is somewhat more difficult. To cause cyanosis and edema of the head, neck, and both

Fig. 29.—Photograph showing the heart and aneurysm after the anterior third of each has been removed. The long piece of paper indicates the normal course of the aorta, while the short piece of paper is placed through the perforation from the aorta into the superior vena cava. On the upper surface of the aneurysm can be seen the remains of the left innominate vein, which was completely thrombosed.

arms it would be necessary to obstruct the return flow of venous blood from these areas. It is conceivable that the aneurysm is pressing on the superior vena cava in this case, but the probabilities are much against it, because it would be very difficult for an aneurysm of the first or second portion of the aorta to obstruct

the superior vena cava, as the latter is normally situated at a considerable distance posterior to the aorta in this particular location.

QUESTION: Mr. C., what do you think are the possibilities of this being a case of an aneurysm of the aorta, with a perforation into the superior vena cava?

ANSWER: Although I have never seen such a case, and I understand they are very rare, it would seem to be the more probable

Fig. 30.—Rear view of the aneurysm and heart, showing the superior vena cava emptying into the left auricle, and at the upper end of the superior vena cava can be seen the perforation which was the cause of the murmur and cyanosis.

diagnosis, if it could be established that the murmur is continuous in character and that its variation is simply due to a systolic exacerbation. The acceptance of this theory would satisfactorily explain the following sequence of affairs:

1. A sudden sharp pain in the chest which was so severe that the patient was obliged to give up work for two weeks, and then

accept a position which required no physical exertion. We could assume that the pain was due to a tear or partial break in the aortic wall, which was presumably already diseased in a man suffering from syphilis.

2. The aneurysm apparently slowly enlarged without causing much trouble when the sudden increase in blood-pressure caused

Fig. 31.—Picture of thorax immediately after the median incision had been made, and the pericardium dissected away to show the relationship of the aneurysm to the heart and to the superior vena cava.

it to rupture into the adjacent superior vena cava. That would explain the sudden cyanosis and swelling of the upper half of the body, associated with a rough thrill and continuous murmur which could be heard in the large arteries on both sides of the neck.

3. The disappearance of the thrill and murmur from the left

side of the neck can be accounted for by a further upward enlargement of the aneurysm, causing a total occlusion of the left innominate vein.

4. The slight cyanosis can be interpreted as being due to the mixing of the arterial blood with the venous blood.

Fig. 32.—Photograph of the chest taken while the patient was still on the autopsy table. The aneurysmal sac has been pulled away from the superior vena cava. At the upper left-hand corner it will be seen that it was adherent to the superior vena cava just below its division into the two innominate veins.

QUESTION: Mr. D., what are the possibilities of this case being due to a rupture of the aortic valve?

ANSWER: The attack of sudden sharp pain, followed by cardiac embarrassment, would make it necessary, of course, to rule out this possibility. This diagnosis can be quickly eliminated

by the absence of water-hammer pulse, the comparatively slight enlargement of the heart, and the impossibility of explaining the edema and cyanosis of the upper half of the body on this contention.

Summary.—Although at first some of us were in doubt as to the character of this murmur, the majority of the staff have decided in favor of the diagnosis of an aneurysm of the aorta with perforation of the superior vena cava, as this is practically the only condition which would account for the presence of a continuous murmur and thrill as well as a sudden appearance of cyanosis of the upper half of the body.

Note.—The 3 cases included in this clinic were shown to the students of the College of Physicians and Surgeons, and at a later date I was able to show them the autopsy specimens. In order to enable the reader to visualize the clinical report and the autopsy findings I am inserting the pictures of the pathologic specimens immediately subsequent to the report of the case.

Clinical and Pathologic Summary.—This case evidently suffered from unsuspected syphilis. It finally attacked his aortic arch so that it was weakened to such an extent that it could not stand the rapid increase in aortic pressure secondary to the effort of lifting a heavy weight. By changing the character of his work the patient was able to compensate temporarily for the presence of the aneurysm. However, the sudden fit of anger caused a weak spot in the aneurysmal sac to give way. Luckily for the patient it burst into a vein. He eventually died from a cardiac failure.

CASE II

Negro, aged fifty-five, who was admitted to the hospital complaining of dyspnea on exertion and more or less constant precordial pain. He said that he had never been ill, with the exception of having had a chancre twenty years ago. During the past two months he has experienced difficulty in swallowing food. He is also troubled with occasional bad metallic cough, and at times he brings up a moderate amount of mucopurulent expectoration. This has never been observed to be blood tinged. The total duration of the present symptoms has been six months, and they have

been gradually progressive in character. The following is a short summary of his physical examination: The patient is a well-preserved middle-aged negro, who lies in bed supported by two pillows. His temperature is 98.8° F., his respiration 22, and pulse 110. The pupils are equal and active. There is no palpable evidence of glandular enlargement or visible evidence of venous engorgement. A distinct tracheal tug is present. In percussing along the upper border of the heart one can distinguish an abnormal area of dulness into the second and third interspaces on the left side, extending 2½ inches from the midsternal line. Over this area there is a visible and palpable pulsation, but no thrill or murmur. The heart is evidently slightly displaced downward to the left, and is otherwise negative. The systolic blood-pressure in the right arm is 120, in the left 130. The aortic second sound is not markedly accentuated. The pulse-rate is 110, otherwise normal in character. Over the left lung posteriorly the breath sounds are somewhat more distinct in character, and inspiration is accompanied by numerous moist râles. The liver is palpable 1 inch below the costal margin. There is no edema of the feet. The reflexes are apparently normal.

Discussion.—QUESTION: Mr. A., what are the most probable possibilities to be considered in discussing this case?

ANSWER: 1. Aneurysm involving the transverse portion of the aorta.

2. Mediastinal tumor.

3. Mitral stenosis with extreme distention of the right auricle and an associated auricular fibrillation.

QUESTION: Mr. B., what evidence have we for and against the diagnosis of aneurysm?

ANSWER: 1. The persistent and increasing precordial pain.

2. The visible pulsation and abnormal area of dulness to the left of the upper part of the sternum.

3. A positive tracheal tug, associated with a hard, brassy cough, and difficulty in swallowing.

Negative.—1. *The absence of any type of heart murmur.*

2. The absence of diastolic shock.

3. The equality of the pupils.

4. The very slight difference in the blood-pressure of the two arms.

QUESTION: Mr. C., will you give evidence for and against the diagnosis of mediastinal tumor?

ANSWER: The symptoms and physical signs which are produced as a result of pressure from an aneurysm could be equally well produced by the pressure of a tumor. These would include the cough, difficulty in swallowing, and pain. We must admit that the tracheal tug could be the result either of an aneurysm or of a mediastinal tumor pressing upon, or becoming adherent to, the left bronchus. The pulsation might be regarded as the normal pulsation of a moderately large transverse arch aneurysm, or it might also be regarded as a transmitted pulsation from the aorta through the medium of a tumor, *but the most important evidence in favor of the diagnosis of mediastinal tumor is the definite absence of a cardiac murmur, as an aneurysm of the first portion of the aorta is almost invariably associated with aortic regurgitation.* However, the regular outline of the abnormal area of dulness, the lack of emaciation, and of glandular enlargement are very strong evidences against the diagnosis of tumor.

QUESTION: Mr. D., what do you think is the possibility of this case being due to some cardiac disease other than that of aneurysm?

ANSWER: In view of the fact that there is no marked evidence of venous engorgement, such as edema of the feet, a pulsating liver, and marked distention of the veins of the neck, it is much more plausible to consider that the slight outward and downward displacement of the heart is due to downward pressure of an aortic arch aneurysm or mediastinal tumor. In addition to these facts, there is a total absence of cardiac murmurs. Absence of cardiac murmurs occasionally occurs in cases of mitral stenosis which are associated with auricular fibrillation and extreme distention of the right heart. It is true that they often show a moderate increase in the area of dulness to the left of the sternum in the third interspace, due to the engorgement of the left auricle, but even in these cases the dulness would hardly correspond with the area just described, and they are invariably

associated with great distention of the veins of the neck, which is not true of this case.

Summary.—In view of the fact that aneurysms involving the first and second portions of the aorta are comparatively com-

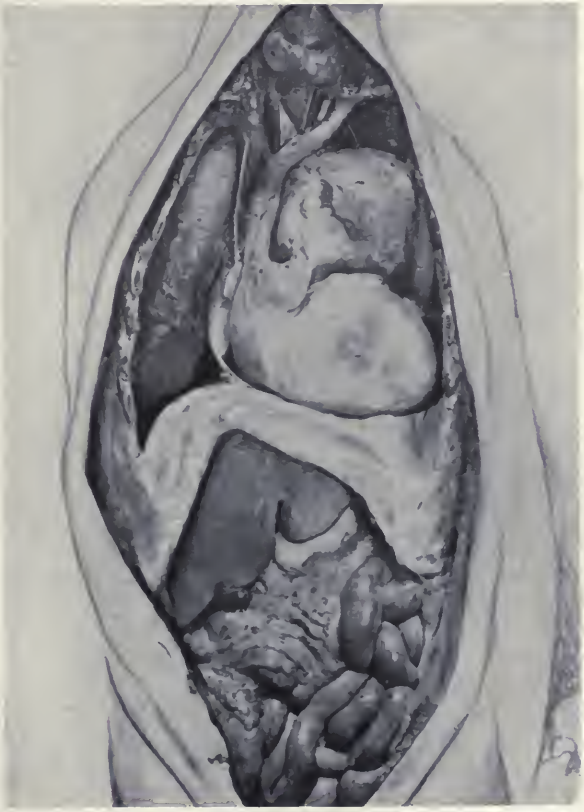

Fig. 33.—Sacculated aneurysm of the first part of the aorta. The pericardium was adherent over the upper part of the sac. The aneurysm pressed on and collapsed the left lung and it also involved the left recurrent laryngeal and phrenic nerves.

mon, it is probably wise to assume that the patient under discussion is suffering from this disease, especially as he has a positive specific history. It must be admitted that a positive diagnosis cannot be made between aneurysm and tumor in this case. But

in this connection it must be remembered that Cabot, in studying a large series of autopsy records at the Boston City Hospital, found that three-fourths of the cases diagnosed at that hospital as mediastinal tumor proved to be cases of aneurysm. We shall, therefore, leave our diagnosis as an unproved but suspected aneurysm of the aorta.

Fig. 34.—Aneurysm of the first part of the aorta cut in section, showing its communication with the aorta and its interior filled with laminated blood-clots.

Autopsy Report.—Figure 33 is a picture taken with the camera elevated 4 feet above the autopsy table. A median incision has been made, and the anterior portion of the thorax has been removed, as well as the anterior layer of the pericardium, in order to expose the heart and large blood-vessels. The heart is dis-

placed downward and to the left by a tumor which is about the size of a medium-sized orange. The left recurrent laryngeal nerve is adherent to and embedded in the wall of the tumor.

Figure 34 shows an enlarged view of the heart and its relation to the tumor and the lungs. The anterior third of the tumor and of the aorta has been removed, showing that the tumor consisted of an aneurysmal sac projecting from the left side of the ascending aorta. The sac was completely filled with an organized blood-clot, so that the aneurysm had all the physical characteristics of a solid tumor.

It is therefore easy to see why it was impossible to differentiate between the conditions during life.

CASE III

Introduction.—I shall first give you a short account of the history and physical examination of the patient as taken from the chart on the day of admission to the hospital. I wish you to follow it carefully, as I intend to ask you to examine this patient and state whether you agree with the original diagnosis which was made four days ago.

J. K., admitted to the hospital complaining of pain in left upper chest, which was increased on deep inspiration. Duration two days. He had had scarlet fever during childhood and gonorrheal infection four different times. The last occurred six years ago. He has had several attacks of rheumatism. The first occurred ten years ago after exposure to wet and cold. It was characterized by sudden onset of swelling of the knees and ankles. Duration four days. He had a second short attack four years ago, and each winter subsequent to that date. Only the ankles and knees have been involved up to the present. He denies specific infection and says that he has never had pain in the chest or any cardial respiratory symptoms. Two weeks before entrance to the hospital the patient had a sudden attack of acute inflammation in the elbow, which later extended to his shoulders. This attack lasted ten days. The day before admission the patient was taken with severe and sudden pain in the left chest, and this was increased by deep inspiration. It was accompanied

by moderate dyspnea and expectoration of bloody mucus. The patient is an adult white man about sixty years old, lying in bed, complaining of pain in the left chest on deep inspiration, although he does not appear acutely ill. The pupils are equal, regular, and react to light and accommodation. The left upper lobe apparently shows complete consolidation. There

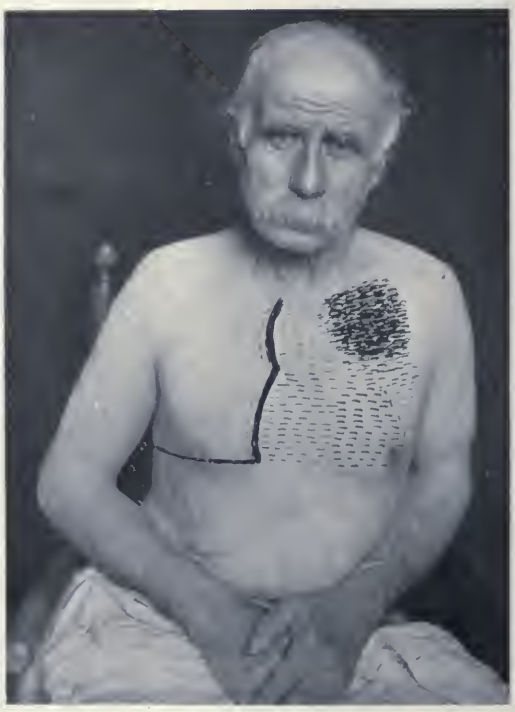

Fig. 35.—Admitted to the ward as case of pneumonia, involving the left upper lobe.

is dulness on percussion. Breathing is bronchial in type with prolongation of expiration, and at the end of inspiration many fine and coarse crackling râles may be heard. Percussion causes severe pain in the left upper chest. The heart is apparently not enlarged, the sounds are distant and obscured by the lung sounds. No murmurs are audible. Pulse is 110 and regular. Abdomen, glands, and extremities negative. Knee-jerks present

and equal. The temperature is 102° F. Respiration 30. Leukocyte count is 17,600. Polymorphonuclears 81 per cent. *x*-Ray shows apparent complete consolidation of the left chest. A provisional diagnosis of lobar pneumonia was made by the

Fig. 36.—*x*-Ray plate taken on the day of admission.

intern staff, and was confirmed by myself and one of my colleagues.

Discussion.—QUESTION: Mr. A., will you kindly examine this man and tell us what you find in regard to his condition today, and

whether you agree with the provisional diagnosis of lobar pneumonia?

Reply: The patient seems to feel fairly comfortable and is not coughing much. He says that he can lie on his left side, which he could not do before on account of the severe pain. There is still tenderness to percussion over the left upper lobe anteriorly and the percussion note seems to be particularly flat in this region. Bronchial breathing can be plainly heard over the entire left upper lobe, but not over the lower lobe. Over the left base one can hear many coarse and fine moist crackling râles both anteriorly and posteriorly. On consulting the chart I see that the temperature is 101° F. Respiration 24 to 28. Pulse 90 to 100. The leukocyte count is 20,800. Polymorphonuclears 81 per cent. I also note that the left knee-joint is swollen, red, and tender. It apparently contains fluid and has been aspirated. The laboratory report shows that although the fluid obtained contains many pus-cells, the smears and culture were negative. I should think that the patient is at present suffering from a lobar pneumonia involving the left upper lobe. The lower lobe is in a stage of resolution. It is probable that he also has a pneumococcic infection of his knee-joint.

Dr. Snyder: I have taken the trouble to show this case to impress upon you the importance of a careful and thorough physical examination, and also to impress upon you the fact that you must observe your patients carefully and conscientiously from day to day. You must remember that none of you will ever reach the stage of perfection in physical diagnosis or medical reasoning that will justify you in assuming an air of overconfidence in your diagnostic ability. The day following this patient's admission it was noted that the percussion note over the upper left chest was somewhat peculiar in that it was flat, whereas that over the rest of the chest was dull. A needle was inserted into the second interspace about $2\frac{1}{2}$ inches from the midsternal line with the expectation of finding fluid, but with negative results. It was observed that his temperature was of moderately low type, varying between 100° and 102° F., and that his inspiration, although it occasionally went to 28 to 30, for the most part re-

mained between 22 to 26 per minute. Another careful physical examination brought out two very important physical signs. The patient had a very distinct and easily palpable tracheal tug and a subacute prostatitis and seminal vesiculitis. We therefore,

Fig. 37.—Autopsy picture showing heart, aorta, left lung, and the position of the large clot which conducted the bronchial breathing to the anterior chest wall.

in all probability, have to deal with a large transverse arch aneurysm which is associated with some type of secondary pulmonary consolidation. It is evidently not of tuberculous origin because repeated sputum examinations have been made and are negative for tubercle bacilli. Very frequently the partial compression of

the bronchus causes a retention of bronchial secretions, and this seems to serve as a starting-point for a peribronchial pneumonic consolidation. The fact that this patient has had attacks of sharp excruciating pain in this area associated with the expectoration of bloody mucus would lead one to conclude that the consolidation was intimately connected with hemorrhages into the bronchi as a result of erosion of the bronchus by the aneurysm. We still have to explain the temperature and joint symptoms. In this connection I wish you to recollect that he has had four different attacks of gonorrhea, and that the first attack of rheumatism occurred previous to his last attack of gonorrhea. He is now suffering from a subacute prostatitis, and in the absence of any other known source of infection (especially as the heart valves have not been involved and the fluid taken from the knee-joint showed negative cultures) it is probably most reasonable to assume that the patient is suffering from a coincident gonorrheal arthritis.

Subsequent History.—The patient died suddenly at a later date, apparently as a result of a large hemorrhage into the bronchi, as he expectorated a great quantity of bright blood.

Autopsy Report.—This shows that the patient was suffering from a moderately large aneurysm involving the transverse and the first portion of the descending aorta. On the anterior surface of the aorta at about the junction of the transverse and descending portions was a perforation about $\frac{1}{2}$ inch in diameter. This evidently occurred at the time the patient had the first sudden sharp pain in his left upper chest two days before his admission to the hospital. The patient was saved from sudden death at that time by the fact that the lung had previously become firmly adherent to the aneurysmal sac, to the adjacent pericardium, and to the anterior chest wall. In spite of these adhesions a sufficient amount of blood was forced through the opening to form a large thrombosed clot about the size of a man's hand over the left lobe. The clot had formed a solid medium which had transmitted the bronchial breathing from the bronchus to the chest wall. On the posterior and inferior surfaces the aneurysm had been gradually corroding the left bronchus, and the gradual oozing or weeping of blood from this area had caused

the expectoration of bloody mucus. The collection of blood in the alveolar air-cells had helped to produce the deceptive *x*-ray picture. As a terminal event the aneurysm had burst into the left bronchus, flooding the left lung with blood.

Before closing I wish to express my appreciation to Dr. Harlow Brooks and Dr. Charles Quinby for the use of the first and second cases respectively, and to Dr. John Larkin for the use of the autopsy material.

CLINIC OF DR. WALTER JAMES HEIMANN

POST-GRADUATE MEDICAL SCHOOL

THE RELATION OF INTERNAL DISTURBANCES TO DERMATOLOGIC CONDITIONS[1]

Intimate Correlation of Dermatoses with Constitutional Disturbances. False Conceptions of Cutaneous Medicine. Essential Features of Dermatoses as a Whole. Types of Acquired Dermatoses; Numerous Combinations of Manifestations and Many Clinical Variations. Besnier's Doctrine of Skin Reactions. Broad Principles Guiding Modern Interpretation of Etiologic Factors. Skin Manifestations: in Metabolic, Gastro-intestinal, Excretory, Vascular, Blood, Central Nervous System, Endocrinal System, and Body Chemistry Disturbances. Focal Infections. Cases Illustrating Eccentric Behavior of Psoriasis Following Dietetic Therapy. Rational Basis of Skin Phenomena.

IN recent years, and particularly in America, an attempt has been made to correlate many of the so-called cutaneous diseases with internal and general medical disturbances. The expression "so-called cutaneous diseases" has been employed advisedly, because the feeling is growing that many of the dermatoses formerly considered clinical entities are merely syndromes. In this sense it is important for the general practitioner to realize that a working knowledge of dermatology may lead to the recognition of general disturbances that would otherwise escape his attention, and it is important for the dermatologist to realize that he, in turn, should stop regarding dermatology as a narrow specialty and view it rather with the eyes of an internist.

[1] Clinical lecture on dermatology, delivered June 4, 1918, at the Post-Graduate Medical School.

In reviewing the modern history of dermatology it becomes apparent that a system of inadequate language has been built up side by side with a science. Numerous conditions closely related, because of superficial distinctions, have actually been regarded as dissociated clinical entities. This has resulted in a confusion, if not chaos, in our concepts of cutaneous medicine, and it is likely that it will take a century before dermatology can be reinterpreted in terms of contemporaneous medicine. It must not be assumed that because dawn has risen in the east of the dermatologic night that the passage of the sun will be unretarded, but it is safe to say that it is only through readjustment of dermatology to the laws of morbid biology that we can ever aspire to a high noon in this branch of medicine. The faintly lighted horizon gives some encouragement.

Before endeavoring to point out what the relationship is between dermatology and general medicine it will be necessary to discuss some of the essential features of dermatoses as a whole. In order to do this it would be wiser to restrict the topic under discussion to acquired dermatoses of which the causation is not definitely known. This eliminates all congenital malformations, tumors, and infections of the skin. The conditions remaining may be roughly classed in the following groups: urticaria, dermatitis, the scaling skin diseases, the lichens, and the vesiculobullous eruptions.

It must be remembered that the skin is a tissue enveloping many other organs and tissues. It must further be remembered that there can be no great independence of the skin from the rest of the body, for if there were, the skin would not react as it does in the acute exanthemata for example. As soon as this is admitted, the bridge has been crossed which dermatology has to traverse to be included in the rational branches of medicine.

If the skin is slightly inflamed, it gets red. If the inflammation continues, the skin swells. If the inflammation is still further sustained, there is a tendency to chronic changes. Most dermatoses are inflammatory, and in understanding this the dermatologist becomes a gross pathologist with special reference to the integument. Inflammation in the skin, as anywhere else,

may be acute or chronic, and prevailingly dry or moist. If acute and not long sustained very few permanent alterations occur. If chronic, the alterations endure for a greater or less length of time; some, indeed, are permanent. If the inflammation is prevailingly moist, blisters or blebs form on an otherwise altered or unaltered base, according to whether the inflammation is of short or long duration. In dry forms of inflammation there is scaling. Skin diseases vary clinically according to the combination in which the phenomena enumerated occur. It is thus apparent that the skin, precisely as any other tissue, reacts to morbid forces in a few simple ways. Because the skin covers a wide surface and because the combinations in which its responses develop are so numerous, there has been a tendency to regard each individual group of responses as a clinical entity. If the kidney were spread out thin over the entire body we would probably have as many types of nephritis as we have of skin diseases. Conversely, if the skin were crumpled into the compass of a kidney we would recognize about as many types of skin inflammation at autopsy as we do of nephritis today.

It is a matter of thirty years or so since a French dermatologist, Besnier, postulated the somewhat aphoristic doctrine of skin reactions. This doctrine sums up the foregoing, in that it implies that a great many diverse causes can produce one type of skin response, and also that the same cause in different individuals and at different times can produce divergent skin responses. To illustrate the first series of phenomena there is no better example than urticaria. Every one realizes how many factors, both external and internal, can produce hives: the mosquito, the nettle, the jellyfish, egg-albumen, bivalves, and other sea food are part of the inexhaustible list capable of producing a wheal, and yet all wheals look substantially alike. The wheal is not the disease; it is simply a tissue reaction indicating that the body is struggling against a poison. The type of the poison and the character of the body response in the struggle are the disease, and the wheal is simply an indication of morbidity. On the other hand, arsenic or the iodids or bromids serve as illustrations of how a single given substance may provoke the most diverse skin

responses. Arsenic is able to cause herpes, hyperpigmentation, hyperkeratosis, simple dermatitis, and erythemas resembling the exanthemata. Iodids and bromids may cause toxic erythema, chronic granulomas, varicella-like eruptions, a certain form of acne, and the like. This indicates the fact that in different people a given poison provokes different types of response, varying according to the susceptibility and power of resistance of the individual. It is unnecessary to carry the examples further in order to clarify the subject matter under discussion, for if the principles here involved are broadly applied it will indicate the possible relations and dissociations of causes and effects in the production of what we are pleased to call skin diseases.

All diseases that are not due to anomalies of development, new growths, and pure mechanical influences represent an effort on the part of the body to resist a poison. Nor does it make any difference whether this poison is created within the body or introduced into it from without. Whether it is the result of metabolic disturbances or whether it is the result of infection; whether it is due to functional derangement of the various systems of organs or of the glands of internal secretion or the vegetative nervous system as a whole, the militant factor in disease must be an abnormal substance within the body, however it gets there, and the symptoms of the disease are always an expression of the effort of the body in some way or other to overcome or expel the intruder. In the last analysis disease is always a process indicating a biochemic disturbance. At times the body response is so characteristic or the cause so well known that the disease becomes a clinical entity. More often, and particularly in dermatology, so far as we know, this is not the case. The symptoms of disease are largely subjective, but in cutaneous conditions the range of symptoms is not great, and hence they are of clinically little importance. On the other hand, the objective signs of disease, namely, the lesions themselves, are of great variety in cutaneous medicine and, consequently, of great importance. In internal medicine, because we cannot see the lesions while the patient happily remains alive, the study of symptomatology is more important than that of lesions to the clinician. In

dermatology, since the lesions are exposed to anyone's view, the clinical science of this branch of medicine has tended to become objective.

It is unnecessary to discuss in greater detail the technical aspects of skin lesions. In order to grasp the thesis here being developed it makes very little difference whether you know all of the meticulous distinctions that define the several skin lesions. But it is necessary always to remember, and therefore the matter is advisedly emphasized here, that countless causes may provoke one type of skin lesion, and that several types of skin lesion may be provoked by one cause. The agents provoking cutaneous responses may be found outside of the body or inside of the body. It is more especially with the latter that the present lecture concerns itself.

We must further subdivide internal causes of skin responses into those probably found in the alimentary tract, the excretory system of the body, the cardiovascular system, the hematopoietic system, the central nervous system, and the vegetative nervous system including the glands of internal secretion. In addition to this, it is essential to remember that disturbances of the body chemistry, without any necessarily ascertainable organic changes, play a most important rôle in the causation of dermatoses. At this point it is necessary to recall that any such artificial separation of the enumerated systems from one another and from their respective functions is quite as unphilosopic as it was to build up a system of dermatology without reference to all the other organs in the body. The entire body is a physiologic as well as an anatomic unit. On the whole, it must always be remembered that even though the main expressions of a disease may apparently be referable to one system of organs, the process itself may actually exist in an entirely different system, as, for example, the tachycardia and tremor of Graves' disease, the essential process of which resides in the thyroid gland. Thus we may not logically attempt, particularly at the beginning, to say such and such a group of skin diseases represents an alimentary disturbance and another a renal disturbance, and so on. The matter, in all

branches of medicine, is more complicated, and no more so in dermatology than in the rest.

With these broad principles in mind let us examine what little may be surmised regarding the internal causes of dermatoses. It will perhaps prove to be very little, and still that little is considerably more than would be possible if we adhered to the dogma of the early schools. With the profoundest reverence for the service that Hebra rendered to the science of dermatology, it is nevertheless a fact that he was largely a visual dermatologist. Probably no other worker in his field has had such acute eyes as this venerable Viennese scholar. The real tragedy in the history of the subject was Hebra's ability to out-thunder the teaching of Willan, the father of modern dermatology, who beheld the subject more clearly than any of his successors for a century. It is only within the last decade or so that it has again become possible to realize how superior was the attitude of the English school. Advances in modern medicine will enable us again to take up the thread of the work that was interrupted one hundred years ago at Willan's death.

Numerous cutaneous manifestations are referable to alimentary disturbance. Rosacea, seborrhea, and acne vulgaris are among them. In rosacea we often find an associated chronic gastritis, sometimes gastric ulcer, very frequently hyperacidity, and carbohydrate indigestion. Chronic alcoholism and the extensive use of tea and coffee, probably through their effect on the stomach, are also frequently the underlying factor in rosacea. The proof of this lies in the fact that the skin manifestations diminish or disappear when the underlying cause is controlled. In women, certain pelvic disturbances, particularly in connection with the menses and menopause, appear to bear a causal relation to rosacea. How this is to be reconciled with the gastric disturbances it is hard to state unless it be through the intermediary of the endocrinous system. Chronic enterocholitis, particularly when due to carbohydrate fermentation, also causes rosacea. Seborrhea in all of its forms is not only frequently associated with rosacea itself, but also with any and all of the underlying causes of rosacea.

Acne vulgaris is a disease of the young. It is closely related in some of its phases to seborrhea, and its underlying causes comprise the same list as those in the preceding malady. It is unquestionably also related to causes determined by the onset of puberty, since it tends to disappear when adolescence is ended.

The three conditions just mentioned are, in a large number of instances, associated with hyperglycemia. The significance of the disturbance of sugar metabolism with relation to the glands of internal secretion will be discussed a little later, but it is apparent that we have isolated a group of cutaneous reactions which more or less consistently are related to a combination of gastro-intestinal and metabolic disturbances referable to unbalanced carbohydrate metabolism. The clinical application of this knowledge is found, when in treating cases of this type, better results are obtained by giving consideration to the underlying factors as well as to the local.

The form of dermatitis known as eczema when not due to an ascertainable outside cause is very frequently associated with chronic constipation, protein putrefaction, and alkaline feces. This is also the case in the chronic urticarias, such as prurigo, and not infrequently in dermatitis herpetiformis. Associated with this phenomenon and in these conditions, particularly with the last two, nitrogen retention occurs constantly or periodically. Thus a second group of cutaneous reactions can be isolated which is more or less consistently related to disturbances of protein digestion and nitrogen metabolism. Here again the therapeutic test is of corroborative value for cases of this type, treated not only locally, but with cathartics, eliminatives, and intestinal irrigation, run a shorter course than with local treatment alone.

A feeling seems to exist, based upon inferences published by Bulkley and the really scientific work done by Schamberg, that psoriasis is also the result of a disturbance in nitrogen metabolism, but this is not entirely clear. Psoriasis is most capricious; it comes and goes as it chooses without relation to the habits, life, or diet of the patient. It sometimes gets better and sometimes worse during pregnancy, lactation, or menstruation. It even varies in this respect in the same individual. It gets better

or worse during chronic cachectic or acute diseases. It manifests itself equally on a protein or a vegetable diet. An eminent dermatologist in New York, intending to impress his audience with his acumen, said to a new patient who presented herself at his clinic for treatment for psoriasis, "Stop eating meat and eggs." This was his first interview with the patient and he had taken no history. Her reply was: "I never tasted either in my life."

Another case comes to my mind of a woman with a universal psoriasis who, having been put on a rice diet, developed a generalized erythroderma and a mucous colitis, with acid stools and a marked starch indigestion. When put on a mixed vegetable and protein diet, with no other local treatment than vaselin, her skin cleared up in two weeks.

Still another case: A young matron, immediately after having lost 20 pounds in weight, developed a recrudescence of her psoriasis, a fact which is markedly at variance with Schamberg's findings. This loss in weight was not due to ill health, but to an energetic out-of-door existence following a sedentary winter. As a matter of fact, although we know nothing of the cause of psoriasis, it is as easy to find arguments against its origin in disturbed nitrogen metabolism as to find arguments for it.

The relation of dermatoses to excretory disturbances is, so far as our present knowledge goes, slight. Sometimes in chronic nephritis, with or without nitrogen retention, there is itching of the skin and sometimes vesicles or papular eruptions of the eczema or prurigo type are observed. Considering, however, how common nephritis is and how infrequent its association with these conditions, one must look further when they coexist instead of blaming the skin condition on the kidney condition. It is far more likely that the two are individual, although associated expressions of a common underlying cause. Chronic nephritis is, in the main, the result of a sustained intoxication which at the end of years and by means of its effect on the general circulation, both anatomic and physiologic, leads to morbid changes in the kidney. In some instances there may be gangrene of the skin, but this can in nowise be

ascribed directly to the renal changes. As a matter of fact, it is a local circulatory change that precedes the dermatosis.

This brings us face to face with the relation of cardiovascular and simple vascular changes to skin diseases. Inflammations of the arteries, whatever their original cause, when the nutrition of the skin is disturbed are capable of producing such gangrene as one sees in leg ulcers, Raynaud's disease, scleroderma, perforating ulcers, decubitus, chilblains, and the like, and in each one of these conditions the immediate cause is a vascular disturbance. This vascular disturbance, however, may be due to vasomotor, mechanical, or toxic causes. In cardiovascular disturbances, when through early decompensation the excretion of the body is disturbed, such dermatoses may arise as are due to disturbed nitrogen metabolism. This, in turn, refers us back to the relation of the kidney to the skin. Unquestionably, an extensive skin disturbance throws an added excretory burden on the kidneys and vice versa, and thus, although it is probable that as time goes we will recognize more cutaneous conditions dependent upon the cardiovascular renal system, at present we can only get an inkling of the fact.

Similar cutaneous changes, such as those summed up under the rubrics of purpura annularis telangiectoides, angioma serpiginosum, dermatitis hæmostatica, and Schamberg's progressive pigmentary disease, are referable to anatomic changes in the skin vessels. These changes lead to a dilatation of the vessels, purpura, pigmentation, and atrophy, with or without frank gangrene. What the underlying causes of the vessel changes are we do not know, but a brilliant light has been thrown on the matter in Stokes' excellent paper on syphilitic telangiectasia. Reasoning backward from this, it is possible to infer that in the final analysis the underlying factor in all of these conditions is a toxin with a peculiar affinity for the cutaneous vessels. I recall a patient in my service at the Lenox Hill Hospital, a man fifty years of age, with an extensive dermatitis on what was apparently a seborrheal basis. All conventional treatment for this condition had been in vain. A positive Wassermann reaction necessitated his being treated for syphilis. With his first mer-

cury injection his itching stopped and he very promptly improved. A microscopic examination of his skin showed an extensive endarteritis such as one sees in syphilis. Although seborrheal dermatitis is not included among the syphilids, it is probable that the vascular changes in this man, caused by his syphilis, provoked a skin reaction which appeared to be seborrheal dermatitis, and with the rapid improvement of his cutaneous vessels the dermatitis cleared up. How far-reaching an inference may be drawn from an instance of this sort it is not safe to state, but it amply proves that classic names clear up no mysteries.

Disturbances of the blood, as such, outside of the leukemias, cause very few alterations in the skin. One may practically exclude the primary anemias, so far as we know today, as causes or associated phenomena of cutaneous changes. The leukemias may produce scaling and favor itching spots on the skin of any type, of course beautifully labelled in dog Latin or dog Greek, small itching papules or more voluminous tumors. Closely related to these are the cutaneous changes of Hodgkin's disease, and a condition called mycosis or, better, granuloma fungoides. All of these conditions start more or less insidiously with a prodromal dermatosis resembling psoriasis, scaling eczema, parapsoriasis, or urticaria, that may last for months or years before the papules or tumors appear. There is reason to believe that these conditions are primarily also related to skin sarcomatosis. The entire subject is still rather vague. Sometimes persistent itching papules or even vesicles suggesting dermatitis herpetiformis may be the first indication of leukemia, and a differential blood count will reveal the diagnosis. In another instance every indication will point to leukemia, and the leukocyte count prove to be normal. We satisfy ourselves by regarding such cases as aleukemic leukemia. The practical point to remember is that many itching dermatoses are the result of leukemia, and therefore it is necessary to rule out this possibility when the suspicion arises.

Diseases of the central nervous system cause a great number of skin changes, and it will be impossible to enumerate them

all in this brief space. Suffice it to say that probably there is no immediate connection between the central nervous system and the skin, but there is some remoter cennecting link. In other words, it is the influence of the central nervous system through the means of the vasomotor and sympathetic mechanism that produces the skin alterations. In this sense many of the diseases described in the paragraph on vascular disturbances may be referable to the central nervous system, or the last may influence the skin trophically and produce functional changes which, in turn, determine anatomic alterations. Thus the central nervous system in a great many instances is responsible for various gangrenes, acro-asphyxia, erythromelalgia, Raynaud's disease, scleroderma, and allied conditions. In this connection it is well to emphasize that mental diseases in a peculiar manner may produce dermatoses. People of abnormally low intelligence or of hysteric habitus inflict injuries upon themselves to provoke sympathy or puzzle their medical attendants. These cutaneous phenomena, though obviously not of central nervous origin, at least indicate mental obliquity which the astute observer may detect by careful interpretation of skin phenomena. Recklinghausen's disease, granulosis rubra nasi, and many nevi have been described as associated with congential mental deficiency. It is important here to rule out the element of coincidence inasmuch as the skin disturbances very much more often occur without such psychic phenomena.

Disturbances of sweat secretion, partial or total baldness of certian types, and zoster have all been proved in many instances to be the result of central nervous disease or of injuries to the central nervous system. Zoster particularly is associated with hemorrhages into the anterior horns. Kreibich, of Prague, published a classical monograph on the subject of angioneurotic edema in which he proved experimentally that blebs or blisters could be produced on the skin under hypnosis. It is certainly true that herpes progenitalis often occurs in psychopathic individuals after illicit sexual congress. I recall one case in which simply pointing out this fact to a victim of chronic genital herpes produced a cure.

The relation of skin diseases to disturbances of internal secretion is in its infancy precisely to the extent that our knowledge of the physiology of the endocrine system as a whole is. It is unnecessary to repeat to practitioners that in Graves' disease and cretinism there are certain well-known changes in the skin and its appendages which may be cured by thyroid therapy. The literature is replete with statements to the effect that the administration of thyroid and pituitary extract cure or improve many dermatoses. Particular emphasis has been laid on the value of pituitary extract in scleroderma, and although it has proved valuable in some cases that I have seen, I have never myself treated a patient successfully for this condition by this or any other means. Nevertheless, considering the reliable source of some of the statements, pituitary extract should be given as a routine measure in scleroderma after thyroid therapy has been attempted.

It is possible that the subtler phases of disturbed carbohydrate metabolism registered by an increase in the sugar content of the blood may be referable to the thyroid gland or the pituitary body. If this is so, the conditions dealt with in the paragraph on acne, seborrhea, etc., might be beneficially influenced by proper therapy with extracts from the ductless glands mentioned. One dermatologist in New York treats all his cases of acne with small doses of thyroid extract. My own experience in this respect has not been gratifying except in one case in which very small doses of the substance combined with strychnin were prescribed. The use of pituitary extract in excessive hairiness, particularly in fat young women of the masculine type, has a logical basis, but when practically applied I, personally, have not found it useful. Nevertheless, there is enough truth and enough scientific foundation in the entire matter to warrant further efforts tempered with optimistic skepticism and restraint. The disappointments that are experienced in using ductless gland extracts are perhaps due to the undeveloped state of the science of endocrinology as a whole, and it is not fair to swing from irrational extravagance to equally irrational mockery of these therapeutic agents.

In this connection it might be well to refer particularly to the use of suprarenal extract in dermatology. In cases due to known or presumed disturbances of the suprarenal glands, such as Addison's disease and various other pigmentary disturbances, the administration has been of no use. On the other hand, in anaphylactic phenomena of the skin, such as urticaria and angioneurotic edema, the substance is often valuable. I have seen at least half a dozen patients with chronic urticaria relieved and two of them cured, and at least a dozen cases of acute urticaria cured with from two to five injections of suprarenal extract. In one patient with angioneurotic edema of the upper eyelid the symptoms were immediately controlled by instilling a drop or two of the extract in his conjunctival sac, and subsequently it was possible to prevent further recurrence by determining, by means of percutaneous tests, the particular protein which caused his disease.

Disturbances of body chemistry as a whole, partially independent and partially referable to the foregoing, have a bearing on skin diseases. Thus, as already stated, disturbed nitrogen and sugar metabolism are often at fault. Without repeating anything that has already been said, it is necessary for a moment to refer to diabetes in its relation to the skin. The diabetic may suffer with ordinary evanescent dermatitis, intertrigo, furunculosis, and skin gangrene. It is impossible to state whether it is the sugar itself or the underlying cause of the diabetes that produces the skin changes, but at least in gangrene the alterations are due to vascular disturbances and in furunculosis the condition may be due to the excess of sugar in the blood, precisely as in acne and rosacea. Disturbance of sugar metabolism is certainly at the root of xanthoma diabeticorum, while disturbance of fat metabolism is responsible for xanthoma tuberosum. There is this difference between the two, however: the latter is incurable and the former disappears when the sugar leaves the urine. This indicates that an increased knowledge of human biochemistry will undoubtedly throw light upon other dermatoses still considered etiologically obscure.

The relation of allergy and general sensitization to the pro-

duction of skin disease is a fascinating subject still in its infancy. Aside from the problems of sensitization that play a rôle in infectious disease there appears to be a substantial group of cutaneous reactions depending upon local sensitization of the skin, or general sensitization of the body with skin responses, provoked by alien proteins. It is with the latter group that we are more concerned. Unquestionably, urticaria and prurigo and probably some forms of eczema and possibly dermatitis herpetiformis may be so caused. The test in each instance would depend upon discovery either by eliminating offending proteins or by determining their pathologic relationship to the disease by percutaneous tests in the sense of von Pirquet. The experiments of Schloss in connection with egg, walnut, and almond urticaria blazed the trail in this country at least. Proteins have been isolated from all the common foodstuffs, a good many flowers, and from the hairs of many domestic animals. Unquestionably, their causal relationship to some of the conditions mentioned has been established. In the hands of the scientifically and judicially disposed this method of determining etiology will prove of great practical value. There is danger though in the misuse and misinterpretation of these reactions on the part of enthusiasts who constantly look for medical toys to play with in a pseudoscientific spirit, or who regard every new biologic test as a milestone on the royal road to diagnosis which is ordinarily paved, not like the path to Hades with good intentions, but with mental indolence. All of these new discoveries will not make medicine easier, but harder, because more complicated, and percutaneous tests with various proteins unless properly read, studied, and classified will not clear up, but will confuse our concepts of disease causation. In a case recently studied this method of diagnosis proved to be of great value. The patient, already cited in an earlier passage, was a man with angioneurotic edema of the left upper eyelid which upon close observation was found to recur suddenly after midnight on a given day in the week. He had been for years in the habit of having buckwheat cakes for supper on this day. He responded percutaneously to buckwheat with a very marked

reaction, and elimination of this food caused the disappearance of the disease. Examples of this sort are multiplying in the literature, and probably we may ultimately find this diagnostic method of as great value in dermatology as Cooke has found it in hay-fever. I must be forgiven for concealing my scientific enthusiasm in this field under great conservatism, for I do not think the time yet ripe for statements that may in the future be interpreted as jejune.

Another phase of the relation of internal medicine to dermatology is embraced in the now popular medical tango of focal infection. Undoubtedly the Streptococcus viridans and other streptococci tucked away in a tooth abscess or a tonsil or even an appendix may and do produce far-reaching results in the joints and heart valves, and they may unquestionably and unquestionably do produce some skin reactions. But the pendulum has swung too far. They do not and cannot explain every cutaneous disease, from the pimple on a young girl's chin to a prickle-celled cancer, as some of the protagonists maintain. At the last meeting of the American Medical Association it was stated by one of the speakers that he had seen, in two patients, dermatitis herpetiformis disappear after some offending teeth had been extracted. This is not to be doubted. On the other hand, I myself have seen a case of dermatitis herpetiformis for the first time make its appearance after similar dentistry. Then, again, I recall a patient who had what was clinically pityriasis rubra of Hebra. He was told by his physician, in the rôle of Job's comforter, that he would positively die very soon. In order to make his last days comfortable he had his teeth drawn. In two weeks his skin was normal and the man is living now, five years later, perfectly well. Cases of urticaria, prurigo, erythema multiforme, and erythema nodosum have improved after the removal of infectious foci. Other cases have not. On general principles it is to be urged that when an abscess exists in the human body it ought to be removed, and if certain incidental, far-flung symptoms then disappear we may reasonably infer that the abscess caused the symptoms. We are not yet, however, in a position to argue

backward, and we cannot tell when given phenomena are produced by a focal infection. Nor does it always follow that when the removal of a focus of infection is succeeded by a disappearance of symptoms, that we may place the blame for the latter upon the former. The most difficult thing the human mind has to combat is *post hoc ergo propter hoc* reasoning. With all due respect to the important rôle played by focal infection in the etiology of dermatoses, it is nevertheless desirable to be cautious about the exclusive adoption of the latest medical waif that appeals to our hearts rather than to our minds.

This, then, represents a survey of the few facts and hypotheses that exist in connection with the relationship of internal medicine to abnormal skin phenomena. It is hard to predict precisely whether the paths indicated will lead anywhere, but it is certainly necessary constantly to try to explain skin phenomena on the basis of rational medicine, and to put an end to the arbitrary isolation that dermatology has maintained in clinical medicine. The skin participates in disease processes and does not possess a series of processes peculiar to itself. It will be the duty of future dermatologists with the viewpoint of internists to work out the details of the relationship of dermatology to internal medicine.

CONTRIBUTION BY DR. MURRAY H. BASS

NEW YORK

THE CUTANEOUS MANIFESTATIONS OF ACUTE RHEUMATIC FEVER IN CHILDHOOD[1]

Diagnostic Importance of these Cutaneous Manifestations in Childhood. List of Common Lesions. Case of Simultaneous Rheumatic Erythema and Chorea. Erythema Nodosum of Rheumatic Origin; Illustrative Case. Purpura Rheumatica with Report of Case. Types of Rheumatic Erythema. Dermatoses with Rheumatic Submiliary Nodules in Heart Muscle. Report of Case of Erythema Multiforme with Aschoff Cells Demonstrated at Autopsy. Consideration of Aschoff Bodies and Their Significance in the Diagnosis of Rheumatism. Conclusions.

THE cutaneous manifestations of acute rheumatic fever are more commonly met with in childhood than in adult life, and are of considerable importance from the standpoint of diagnosis. The lesions may be grouped under the head of erythema, urticaria, purpura, and edema. Considerable confusion exists in regard to these lesions, since each one of them is merely a symptomatic expression of the action of the rheumatic poison on the skin. It must, therefore, be clearly understood that any of these lesions may appear in the course of other diseases where they are the result of toxins other than the rheumatic. In other words, we may have erythema or urticaria in children who are not in any way suffering from rheumatism. The same skin lesions, however, so often make their appearance in conjunction with typically rheumatic symptoms that one is forced to include them among the clinical manifestations of acute rheumatic fever.

[1] Based on a Demonstration of Cases and Specimens before the Pediatric Section of the New York Academy of Medicine, May 9, 1918.

Quite recently, moreover, histologic studies have tended to confirm the above-mentioned relationship between skin lesions and rheumatism in the study of the so-called "rheumatic nodule" of the skin and the submiliary nodules in the heart muscle, for there appear to be certain elements of resemblance between the microscopic appearance of these two structures, to which Coombs and others have called attention. This similarity of structure is certainly suggestive and is well worth further investigation.

Not only is this similarity of lesion demonstrable, but I am fortunate in being able to present a case of marked erythema marginatum accompanying acute rheumatic carditis in which postmortem examination revealed submiliary nodules in the heart. In spite, therefore, of any arguments to the contrary, there can be little doubt that certain skin lesions should be regarded as manifestations of acute rheumatic fever, and in the following pages will be found several cases of rheumatic infection in which the cutaneous lesions were of importance.

Case I.—Seymour B., aged three, was brought to the Mount Sinai Dispensary in May, 1917, on account of an eruption of the skin. At the age of a year and a half he had measles. He had frequently suffered from sore throat. The eruption appeared a few days before his visit to the dispensary, and spread over the back and extremities, accompanied by slight itching. There was no history of digestive disturbance, and the bowels had been regular. There was no history of drug ingestion. The mother stated that the child had had slight fever. He had never before had any skin eruption.

Physical examination showed a fairly well-nourished, pale boy, with a temperature of 101° F. On the extremities and buttocks there was an eruption of many discrete, violaceous, shiny, raised, hard, flat maculopapules varying in size from a grape-seed to a dime. The eruption was most profuse on the extensor surfaces about the knees and elbows, and especially so over the buttocks (Fig. 38). The tonsils were hypertrophied and congested, but there was no exudate. Otherwise the physical examination was negative.

On account of the identical type of eruption and the same

distribution seen a few weeks before in an adult suffering from acute rheumatic arthritis and endocarditis, the diagnosis of rheumatic erythema was made and salicylates were prescribed. In spite of the medication, however, three days later the child developed chorea, and one week later mitral endocarditis.

Fig. 38.—Erythema papulatum (Case I), showing distribution and character of lesions. Boy aged three years suffering from chorea and mitral endocarditis.

In July, 1917, a tonsillectomy was performed, following which the boy, though retaining a mild mitral insufficiency, was apparently in good health until April 1, 1918. On that day he again appeared at the dispensary because of a simultaneous recurrence of the eruption and chorea. The mother stated that a few days

previously the boy had complained of pains in his feet and had become irritable and feverish. The eruption was identical with that observed one year before, both as to its character and its distribution. The exhibition of salicylates and rest in bed seemed to improve the condition temporarily.

On July 3, 1918, the boy was seen again, with chorea much more marked, and with a very profuse crop of lesions of the erythema papulatum type, as before noted. The heart lesion was apparently unaffected by the therapeutic measures taken, and was evidenced by a loud blowing apical systolic murmur transmitted to the axilla, accompanied by signs of enlargement.

To recapitulate: A boy of three, previously well, reveals an eruption of erythema papulatum, accompanied by slight fever. One week later he develops chorea, and a few days after that mitral endocarditis. Under appropriate treatment the chorea and the skin lesions disappear and the child shows no acute symptoms for a period of a year, when the chorea and erythema again appear simultaneously.

Another type of cutaneous lesion concerning whose relationship to acute rheumatic fever much has been written is erythema nodosum. Although there is much in favor of the view that erythema nodosum is a specific disease entity, there are so many instances reported of its association with other rheumatic symptoms that I believe one is forced to conclude that at times this cutaneous manifestation must be due to the rheumatic toxin. True, it is met with less often than the other erythemata, but, as Cheadle says, "Its appearance, from time to time, in immediate connection with the rheumatic outburst seems to stamp it as one of the rheumatic phenomena, and it is occasionally met with in childhood."

I have reported such a case where a child aged two and one-half years developed pharyngitis, torticollis, orchitis, and erythema nodosum,[1] all of them evidently "rheumatic" in origin.

The lesion of erythema nodosum is a shiny, bluish-red, raised nodule, often tender and hot to the touch. It is situated

[1] Jour. Amer. Med. Assoc., May 24, 1913, lx.

commonly on the anterior surface of the lower extremities, may be quite painful, and persists for two to three weeks. The individual lesion varies from 1 to 5 cm. in diameter and is circular or oval in outline and tense to the touch. As pointed out by Sutton, it becomes soft and fluctuating as it regresses, and can then be mistaken for an abscess.

Evidently very closely related to this typical clinical picture is that shown by the case next to be reported.

CASE II.—Sybil S., aged four and a half years, was brought to the dispensary with a history of frequent sore throat and joint pains. The mother stated that the child had had several attacks of great pain in the arm and in the leg, accompanied by swelling of the affected extremity. There was fever with each attack, and each was said to last a few days and then subside, after which the child was apparently well.

Physical examination showed enlarged, diseased tonsils. There was slight tenderness over one ankle-joint. The temperature was normal.

The mother was advised to have the tonsils removed as soon as the acute condition subsided. Two days later she brought the child again, who had now developed one of the attacks. The child looked very sick; temperature was 101° F.; the pulse rapid. Over the left tibia there was a swelling involving more than half the length of the leg, exquisitely tender, hot, tense, and the skin over it was shiny. At first glance the condition had the appearance of a neglected case of acute osteomyelitis of the tibia. The ankle- and knee-joints were the seat of mild arthritis. The tonsils were still markedly inflamed. A radiogram was taken, but the plate showed perfectly normal bone. The Wassermann reaction was negative. Evidently we were dealing with a skin lesion very similar to an enormous erythema nodosum nodule. That this was the case was proved by the appearance two days later of a similar swelling over the right upper arm. The heat and tenderness were just as intense.

Under salicylates the disease cleared up in two days. The child has had her tonsils removed and, to my knowledge, has had no attack since then, now three months.

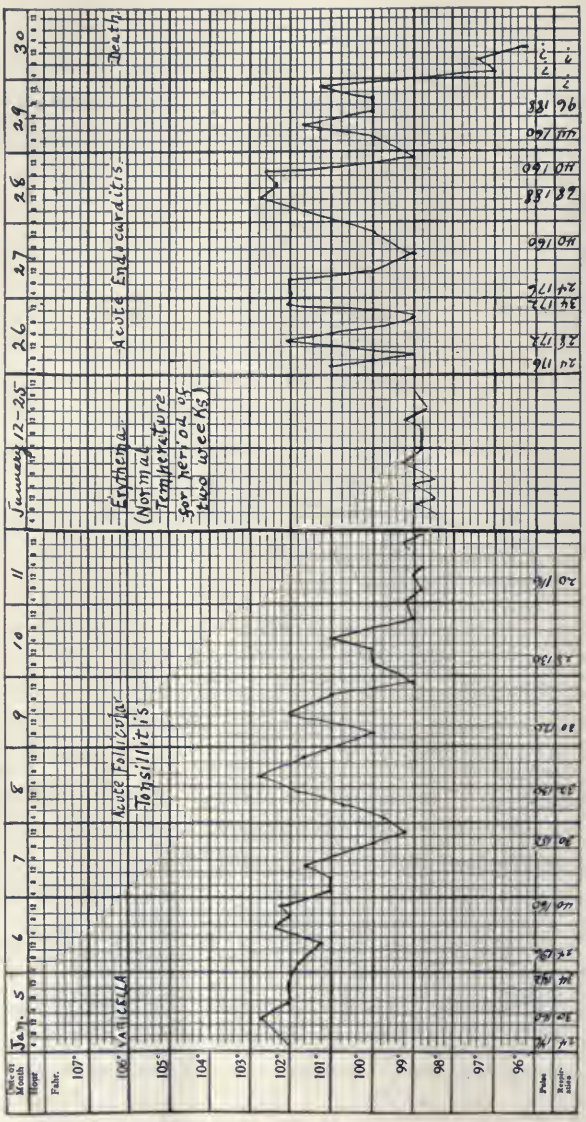

Fig. 39.—Temperature chart of Case II showing progression of illness. Mild varicella on January 5th; severe acute follicular tonsillitis on January 8th: two weeks of normal temperature, during which time an eruption of erythema marginatum made its appearance; fulminating acute endocarditis on January 26th, with death five days later.

This case is of unusual interest since the type of eruption described is unique, and I have found only one similar case reported, that of a large, inflammatory, symmetric, cutaneous exu-

date in a girl of fifteen, suffering from recurring sore throat and arthritis.[1]

A purpuric eruption is at times associated with acute rheumatic fever. As a cutaneous manifestation of the disease it is more common in childhood than among adults. It usually appears during the acute stage, the lesions often being profuse on the skin over the inflamed joints. Much confusion, unfortunately, still exists in regard to these eruptions. Some of the cases are undoubtedly hemophilia, the joint symptoms possibly being due to hemarthrosis; others are simple purpura; others are extreme forms of erythema; and still others are associated with bleeding into the intestinal tract, with severe cramp-like abdominal pains. In spite of this array of clinical pictures there is apparently a small group of cases which may be classed correctly as "purpura rheumatica." How confusing the separation of these disease entities is the following case will illustrate.

Case III.—A little girl, aged six, was seen with severe abdominal pain of one day's duration, accompanied by vomiting and constipation. Examination revealed a tense abdomen, generally tender; temperature of 101° F.; angina without exudate, a slightly swollen and tender left ankle-joint, and a vaginitis of gonococcal origin. The question arose as to whether the child had a gonococcal arthritis and a possible peritonitis. The finding of a few petechial spots over the affected ankle influenced us to wait before finally diagnosing an acute peritonitis, since purpura with abdominal symptoms could not fully be excluded. The following day we were justified in having temporized, for a profuse hemorrhagic eruption appeared over both ankles and knees and the stools became bloody. The case, therefore, was one of Henoch's purpura and the gonococcal vaginitis had evidently nothing to do with its etiology. To call such cases rheumatic is obviously stretching the term too far, yet there are all gradations from the above picture to simple tonsillitis followed by arthritis and purpura.

Probably the most commonly encountered eruptions of rheumatic origin are those included in the term "erythema." Ery-

[1] Riebold: Deutsch. Arch. Klin. Med., 1904–05, lxxxii.

thema marginatum, erythema papulatum, erythema exudativum, erythema multiforme, etc., are all terms used in describing varieties of this skin lesion. Some of them, as was mentioned above, gradually merge into the purpuras, others are associated with pruritis and in form resemble urticaria, while still others, accompanied by swelling, are grouped with angioneurotic edema. Osler long ago recognized this complicated relationship in his description of cases of visceral manifestations in patients showing lesions belonging to the erythema group. The close relationship of the various types of lesion and their dependence on acute rheumatic fever as a cause is emphasized by Oscar M. Schloss,[1] who described 4 cases, synopses of which follow:

Case I.—Rheumatic fever; purpura; urticaria; angioneurotic edema; erythema simplex. Recovery.

Case II.—Rheumatic fever; erythema nodosum; purpura; urticaria; erythema exudativum; intestinal hemorrhage; pericarditis. Death on the twenty-first day of the disease.

Case III.—Follicular tonsillitis; erythema multiforme; urticaria; colic. Recovery.

Case IV.—Tonsillitis; urticaria; erythema nodosum; period of improvement with the occurrence of angioneurotic edema. Sudden onset of pericarditis. Death.

In reviewing the above cases, one cannot help being impressed by the fact that all of these various dermatoses are interchangeable and that they all evidently depend on the same causative factor. Moreover, in the two fatal cases we have complications referable to the heart. This is of great importance in view of the next case I have to report, for although Schloss' cases are clinically to be classified as rheumatism, there is no definite pathologic proof of their being such. The following case, therefore, is of extreme interest, since rheumatic submiliary nodules in the heart muscle definitely stamp the case as one of acute rheumatism.

Case IV.—Florence B., aged three, was admitted to the Home for Hebrew Infants, on the service of Dr. Alfred Hess, on December 3, 1917. Previous and family history were unknown. Physical examination on admission was completely negative. One month later the child had a mild attack of vari-

[1] Amer. Jour. Med. Sci., cxl, 1910.

cella, followed five days later by a severe follicular tonsillitis and cervical adenitis. There was no evidence of joint involvement. Examination of the heart was negative. One week later, January 15th, a very pronounced eruption made its appearance over both elbows, knees, buttocks and, less profusely, on the back. The eruption consisted of raised, dark bluish-red, somewhat shiny, smooth areas, circular or circinate in outline, and of various sizes up to that of a 25-cent piece. These efflorescences remained for about three days and then faded. They were unaccompanied by fever, but the child looked sicker than before and was kept in bed. Examination of the heart at this time was negative. After a period of one week, during which the child appeared to recuperate, the temperature on January 26th rose to 101° F. The child became paler and very irritable, and examination of the heart revealed a double murmur over the mitral area. For four days the temperature varied between normal and 102.8° F.; the pallor and dyspnea rapidly increasing. Signs of cardiac dilatation appeared, with bilateral hydrothorax and puffiness of the face. In spite of vigorous medication the child died of cardiac failure four days after the discovery of heart involvement. There were no petechiæ at any time; no evidence of embolism; the spleen was never palpable, and the urine was negative. A blood-culture was ordered, but the child died before the blood was obtained.

To sum up, then, we have here a child of three years who had a severe tonsillitis, followed after one week by an eruption of erythema multiforme, and one week later by endocarditis, with death from heart failure after four days.

An autopsy was performed and the chief findings follow:

Lungs showed marked congestion. Bilateral hydrothorax, with clear straw-colored fluid.

Liver and *spleen* showed great congestion, the former being enormously enlarged, the latter very slightly.

Pericardial sac contained about 30 c.c. of straw-colored fluid.

Heart.—This was examined for me by Dr. W. Thalhimer, and I quote his report verbatim:

"The heart is slightly larger than normal. Epicardial sur-

face is slightly roughened and shaggy. Right heart is slightly hypertrophied. Right auricle is otherwise normal. Tricuspid orifice is slightly dilated, and scattered irregularly along the edge of closure of the valve are small groups of glistening verruci. Pulmonary cusps show a very slight degree of thickening along their line of closure, but no verruci. Left auricle is considerably enlarged and its wall hypertrophied. Mitral valve shows along the line of closure of the flaps a wart-like vegetative process which extends downward upon the chordæ tendineæ. This vegetative process, however, is glistening and pinkish in color, and has not the appearance of a vegetative endocarditis, but has the appearance of a massive rheumatic verrucous endocarditis. These vegetations are large enough to have slightly narrowed the mitral orifice. The flaps themselves are slightly thickened. Left ventricle is markedly enlarged, its wall hypertrophied to one and one-half times normal thickness. The aortic cusps show along their line of closure a continuous line of minute beaded glistening verruci. The foramen ovale is closed. The ductus arteriosus is not present on the specimen. The aorta is normal in appearance.

"*Microscopic.*—Hematoxylin and eosin stain. The muscle-fibers of the heart throughout are normal in appearance. Great numbers of typical Aschoff bodies are present throughout the section, situated in the interstitial tissue and also around the blood-vessels in the adventia (Fig. 40). All of these bodies are made up of groups of Aschoff cells close to one another, separated, however, at the center of the group by pink staining, granular material. These cells are polymorphous in shape, some of them elongated. Their protoplasm, dense and very finely granular, takes a peculiar stain, being pink with slight purplish tint. The nuclei are relatively large and vesicular and many of the cells contain several nuclei. These Aschoff cells are readily distinguished from fibroblasts, although at the periphery of the group the cells shade off into the connective tissue of the adventitia. In the midst of the Aschoff bodies is an occasional plasma cell and large mononuclear leukocyte. Some of the Aschoff bodies contain thirty to forty cells. In none of

the Aschoff bodies is there any evidence of fibrosis. Gram-Weigert stain failed to show bacteria either in the heart muscle or in the thrombus on the mitral valve."

The clinical course of this case was so rapid and the infection so virulent that bacterial endocarditis (*i. e.*, so-called malignant endocarditis) was suspected. The autopsy findings, however, disposed of this diagnosis and absolutely proved the rheumatic origin of the disease.

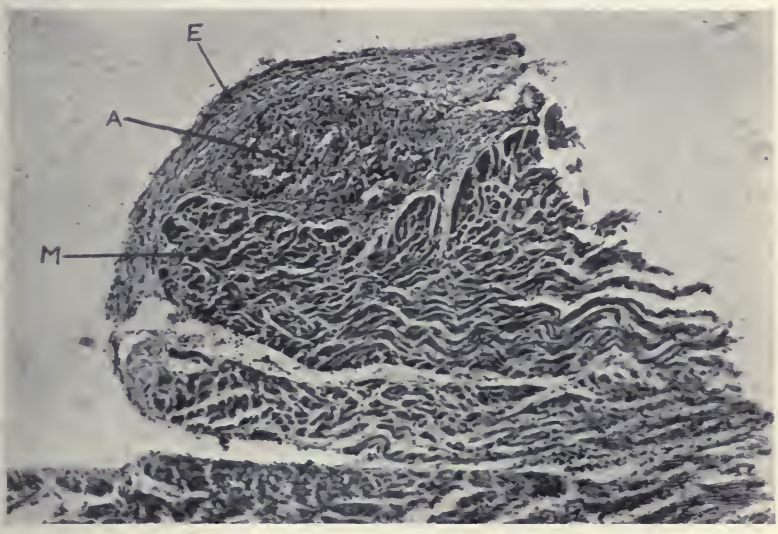

Fig. 40.—Section of left ventricle of Case IV showing submiliary nodule or "Aschoff body" (*A*); endocardium (*E*); myocardium (*M*).

Though there is no strictly pathognomonic clinical sign or symptom of acute rheumatic fever, we do possess definite data concerning its pathologic anatomy. The lesions found in the heart, as above described, are characteristic. The endocarditis is of a special type, always verrucous when fresh. The lesions consist of small, firm, grayish-pink, wart-like nodules situated on opposing surfaces of the valves along the line of closure. "On section, bacteria have rarely been demonstrable, and then in very small numbers; the only organisms found in the sections

or in culture (the latter more infrequently) were streptococci" (Libman).

Besides the endocardial involvement, however, very characteristic changes may be found in the myocardium, in the form of microscopic foci, forming submiliary nodules. These structures, first described by Aschoff and now known as Aschoff bodies, consist of aggregations of large cells scattered throughout the myocardium, mainly in the subendothelial portion, in the course of the medium-sized and smaller blood-vessels. The cells, according to their discoverer, are of connective-tissue origin, and with them are mingled lymphocytes and eosinophilic leukocytes. The nodules are most commonly found in the musculature of the left ventricle.

Aschoff says, "The nodules are found only in cases of positive, or very probable, rheumatic infection, but they are not always demonstrable, since they develop into tiny microscopic, scarcely recognizable perivascular scars. Occasionally parenchymatous-interstitial foci are present besides the specific nodule formation, but these rarely reach any considerable size."

These lesions have been very carefully studied by Thalhimer and Rothschild, whose conclusions follow: "In rheumatic myocarditis foci termed 'submiliary nodules of Aschoff' are present which are characteristic of rheumatic infection. They are most frequently found in the walls of the left ventricle, the auricle usually escaping. The nodules were found in 3 cases of chorea without joint manifestations, proving the close relation of this condition to rheumatism. They were absent in 14 cases of subacute bacterial endocarditis due to the Streptococcus mitis. They were not found in infections of the endocardium with the gonococcus, staphylococcus, streptococcus, or pneumococcus. Even in the absence of a rheumatic history we believe, in accordance with Fränkel, that the presence of Aschoff bodies signifies a previous rheumatic infection. Aschoff bodies are not always found in rheumatic carditis where the affection antedates death by a long period, but the healed remains, represented by sclerotic patches, are present. We suggest that the cases of arthritis characterized by the presence of the sub-

miliary nodules of Aschoff in the myocardium be placed in one group and called, for the time being, 'rheumatism,' and the cases with articular manifestations, yielding positive bacterial findings and no Aschoff bodies, should be classified according to the infecting micro-organisms concerned, and not as rheumatism."

Carey Coombs has also very carefully described these lesions, and he points out that they are associated with the active phases of cardiac rheumatism, and are probably always present in such cases. He believes that the nodules are inflammatory and almost certainly infective in origin. "Their absence from other forms of carditis, and their likeness to the changes seen in other rheumatic lesions, make it possible that they are specific for the rheumatic form of carditis.[1]

In this condition the so-called rheumatic nodule of the skin is of interest. Strange to say, this particular cutaneous manifestation of rheumatism is but rarely encountered in America, whereas it is one of the common findings in England. These nodules are uncommon in adults, but not at all rare in early life. They may appear with any of the rheumatic symptoms, but most often accompany cardiac involvement. They are found beneath the skin, may be single, though usually multiple, and vary in size from a nodule barely perceptible to the touch to that of an almond. They may be quite evanescent, or remain for months. They are rarely tender. Their significance is not only diagnostic, but prognostic, since, as Cheadle says, "in the acute rheumatic fever of children when the nodules are many and large they have an ominous association with progressive endocarditis and pericarditis of the most serious kind; they indicate a grave danger, a carditis which is uncontrollable, and advances almost invariably to a fatal termination."

In the foregoing pages I have shown that in children various cutaneous lesions may make their appearance accompanied by, or as precursors of, rheumatic symptoms; have described illustrative cases of purpuric eruptions and erythema of various types, including a child in whom each of two attacks of chorea

[1] Jour. Bact. and Path., 1910–11, xv.

was accompanied by a profuse eruption of erythema papulatum; have reported in detail the clinical and postmortem findings in a child aged five years in whom an eruption of erythema marginatum was followed after a few days by hyperacute carditis and death. The finding of submiliary nodules in the heart of this case made the diagnosis of rheumatism positive. These cases, I believe, will aid in the classification of these skin lesions and contribute a few further facts toward the establishment of the clinical picture of acute rheumatic fever. Case IV, with its postmortem findings, is particularly important as an additional proof in this connection, justifying the following conclusions reached by Osler: "The relation of the rheumatic poison to the arthritis and the other lesions is clear enough in some cases, but we cannot say that the arthritis is a hallmark by which we can always recognize the rheumatic poison. A great many of the cases of arthritic purpura or the peliosis rheumatica have, I believe, nothing to do with the poison of rheumatism. On the other hand, erythema, with or without purpura and arthritis, may be in children, as are endocarditis, tonsillitis, and subcutaneous fibrous nodules, manifestations of the rheumatic poison—links in the rheumatic chain."

CONTRIBUTION BY DR. OSCAR M. SCHLOSS

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ACETONE BODY ACIDOSIS IN CHILDREN

Acetonuria Versus Acidosis. Acetone Body Production. Effect of Excessive Production of Such Bodies. Directions for Estimating their Significance and Degree. Significance in Obscure Infectious Diseases. Acute Toxic Conditions in Young Children. Cases Illustrating Group in which Increased Acetone Body Production is an Expression of Toxemia; Clinical, Blood, and Urine Findings, and Relation of Average Excretion of Acetone Bodies to Body Weight. Prognosis. Principal Clinical Characteristics. Etiology. Treatment. Summary of Features of Importance.

ACETONE bodies commonly occur in the urine of sick infants and children, and their occurrence is generally without clinical importance. It was believed at one time that acetonuria was synonymous with acidosis, and, unfortunately, like all such errors, the death of this idea has been slow.

Howland and Marriott have recently discussed the significance of acetone body production in infants and children. They emphasize that from our present knowledge the only harmful effect of increased ketone production is the possibility of their requiring sufficient alkali for neutralization to cause acidosis.

It requires a considerable quantity of acetone bodies (acetone, diacetic acid, and beta-hydroxybutyric acid) to impoverish the alkali reserve of the body fluids, and with this as a criterion the increased production, or diminished oxidation, of acetone bodies which commonly occurs in children, is without clinical importance. As pointed out by Howland and Marriott the test used most

frequently for the detection of acetone bodies is the nitroprussid test for acetone, which is an extremely delicate one. The use of such a sensitive test has led to considerable error, as the small amount of acetone bodies excreted in many diseases (fever, starvation) has led to the assumption that acidosis was present.

An estimate of the significance and degree of acetone body production should be based on a quantitative determination of these substances excreted in the urine and present in the blood. The harmful influence of these substances can be determined by estimating the degree of acidosis produced.

Another feature which has tended to exaggerate the importance of acetone body production is the fact that in partial starvation considerable amounts of acetone may appear in the urine (nitroprussid test). In many obscure infections partial starvation occurs, so that the acetonuria has often received unwarranted attention, while the actual cause of the illness is not detected.

There are, however, acute toxic conditions not uncommon in young children which are accompanied by sufficient amounts of acetone bodies to cause definite acidosis. It seems probable that the increased acetone body production is not the cause of this condition, but is merely an expression of the toxemia. The production of these substances, however, may be of great clinical importance. It is this type of case which I propose to discuss. The following history is cited in illustration:

M. C., four years of age. On February 6, 1917, patient seemed slightly ill, refused part of her breakfast, and had a temperature of 102° F. She had slept well the night before and awoke in good spirits. At this time the physical examination showed little of significance. The patient was well nourished, had a good color, but seemed slightly listless. The tonsils and pharynx were moderately congested, but no exudate was present. The temperature remained elevated (as shown by the temperature chart) and the child was at times somnolent and at others very irritable. She took moderate amounts of water and a small amount of food. She complained of no definite symptoms except slight pain on swallowing. During the second, third, and

fourth days of the illness she vomited several times, but this was in no way suggestive of cyclic vomiting. The blood count on the first day showed 21,000 W. B. C., with 76.3 per cent. polynuclears, 21.8 per cent. mononuclears, and 1.1 per cent. of eosinophils. The urine showed an excretion of 3.65 grams of acetone bodies determined as acetone during the first twenty-four hours, 2.86 grams during the second, and 3.1 grams during the fourth day of the illness. On the first day the blood acetone was 78 milligrams per 100 c.c. of blood and the carbon dioxid of the blood plasma bound as bicarbonate (Van Slyke) was 43 volumes per cent. On the third day the blood acetone bodies reached 110 milligrams per 100 c.c. of blood and the plasma bicarbonate was 37 volumes per cent.; a considerable degree of acidosis. At this time there was mild, though distinct, air hunger.

Normal infants excrete from 0.001 to 0.007 gram of total acetone bodies per kilo of body weight in twenty-four hours (Vedder and Johnson). Vedder and Johnson found that in the first twenty-four hours of starvation the average excretion of acetone bodies becomes 0.004 gram per kilo of body weight in twenty-four hours. In longer starvation the excretion may reach 0.03 gram per kilo per twenty-four hours.

Our patient weighed 17 kilos, so that on the first day her acetone body excretion was 0.21 gram per kilo, an amount far in excess of that occurring in starvation. The acetone bodies in the blood were also much above those ever found in simple starvation. Moore found 39.5 milligrams of acetone bodies per 100 c.c. of blood in an infant who had been starved for two days. In acute febrile diseases he found a blood acetone from 11.4 to 23 milligrams per 100 c.c. of blood. I have made a number of determinations of the total acetone bodies in infants and children with pneumonia and other febrile diseases accompanied by partial starvation, and have never found more than 46 milligrams of total acetone bodies per 100 c.c. of blood. The usual figures were much less. It is, therefore, quite evident that the high blood and urine acetone body content in this patient was not due to the effects of fever or starvation or a combination of the two.

On the first day of her illness this patient was given 1 ounce of

3 per cent. solution of sodium bicarbonate by mouth every three hours, but despite this the acidosis increased, as shown by the figures cited. On the third day 10 grams of sodium bicarbonate was given subcutaneously in 3 per cent. solution, and on the following day the plasma bicarbonate had risen to 54 volumes per cent. of CO_2. This amount is practically normal. From this time the child began to improve and there was no recurrence of the acidosis. On the fifth day qualitative tests showed no acetone or diacetic acid in the urine[1] (Fig. 41).

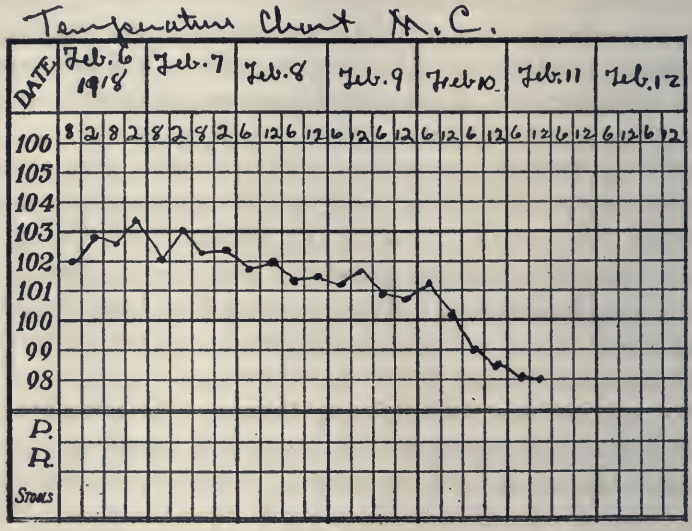

Fig. 41.—Temperature chart of M. C.

I have cited this case in some detail as an illustration of a type of toxic disturbance which is not infrequent. During the past two years I have observed 7 cases which come in this category. There are certain features of these cases which are of sufficient interest to discuss.

There is a tendency for such conditions to occur in families. In three families there were two children affected, and in each instance the second child became ill eight to ten days after the

[1] Howland and Marriott cite cases of obscure acetone body acidosis which are apparently of this type.

first. The nature of the illness was similar in all. The pharyngeal congestion was constant and in all there was leukocytosis. This circumstance suggests two possibilities: (1) that the condition is due to an infection, or (2) that there is a family predisposition to this type of metabolic disturbance. At the present time our available data and methods of investigation are too limited to determine which condition is true. Howland and Marriott have shown that in ileocolitis there may be a very marked increase in the acetone bodies in the blood. It seems quite possible that this may be due to the direct action of the infectious agent. If this assumption is correct it seems possible that other infectious agents may have a similar effect.

There is also an individual predisposition to this type of disturbance. Several of the children have had more than one attack, and the history of a boy of four years of age is of sufficient interest to cite. He had an attack, similar to that of our first patient, in January, 1918. In March, 1918, he became acutely ill, and during the first two days his urine contained large amounts of acetone bodies. On the second day the carbon dioxid tension of the alveolar air was 30 millimeters, indicating a distinct acidosis. He had a slight coryza, pharyngeal congestion, and rhinitis. He vomited a number of times. On the third day Koplik's spots were present on the buccal mucous membrane and on the fourth day the rash of measles appeared. This boy, therefore, developed a distinct acetone body acidosis with measles.

There seems reason to believe that the underlying toxic condition in these attacks of obscure acetone body acidosis and that responsible for cyclic vomiting are of similar nature. In many of the cases of acetone body acidosis vomiting occurs, although it is not as severe or as prolonged as in cyclic vomiting. In some instances, however, a patient will have an attack of cyclic vomiting at one time, and at another an attack of acetone body acidosis without severe vomiting. This circumstance was observed in two patients.

A boy of six years had two attacks of cyclic vomiting and one attack of acetone body acidosis, without severe vomiting,

during the course of nine months. Another patient, a girl five years of age, had one attack of typical cyclic vomiting and one attack of obscure acetone body acidosis within a period of seven months.

The severity of the illness in these cases of acetone body acidosis varies greatly. The case cited at the beginning (M. C.) represents a type of moderate severity. The disturbance may be so severe as to cause death within twenty-four hours. The following case is an example of the fulminating type:

W. G., four years of age, had never been acutely ill, but had been subject to mild digestive disturbances. On February 4, 1918, he seemed slightly listless, but ate with good appetite. On February 5th, at 2 A. M., he awoke his nurse, complained of nausea, but did not vomit. At 9 A. M. he was acutely ill. At this time he was semistuperous, but could be roused. Temperature was 104° F., respirations were distinctly of air-hunger type. His extremities were cold. There was considerable swelling and congestion of the tonsils and pharynx. The carbon dioxid tension of the alveolar air was 22 millimeters and qualitative examination of the urine showed large amounts of acetone and diacetic acid. Blood withdrawn at 9 A. M. showed 140 milligrams of total acetone bodies per 100 c.c. of blood, and the plasma bicarbonate was 36 volumes per cent. of carbon dioxid. Despite the administration of sodium bicarbonate the child died at 5 P. M., after an illness of about fifteen hours.

As a contrast to this case there are others which are exceedingly mild. These mild cases apparently represent the same type of disturbance. The following is an example:

A well, sturdy boy, nine years of age, complained of abdominal pain at 5 P. M. and vomited once. His temperature at 6 P. M. was 104° F., and he complained of being uncomfortable, but was not acutely ill. He seemed rather listless. The pharnyx was considerably congested. Urine voided at this time contained 0.3 gram of total acetone bodies per 100 c.c. At 10 P. M. the carbon dioxid tension of the alveolar air was 31 millimeters and the temperature 101° F. Blood withdrawn at this time showed 86 milligrams of acetone bodies per 100 c.c.

On the following morning the temperature was normal, and beyond a slight sore throat the boy seemed well. There were no further disturbances, and on the next day, thirty-six hours after the onset of the attack, he attended school.

In six of the patients there has been an evident inflammation of the tonsils and pharynx during the attack. Just what relation this bears to the actual cause of the toxic symptoms is difficult to determine. It seems quite possible, however, that this inflammation may represent an infection which is the causative factor just as the infectious agent of ileocolitis may be responsible for the acetone body acidosis which occurs in this disease. It is of sufficient interest to note that two children who were subject to cyclic vomiting and also to attacks of obscure acetone body acidosis, always developed pharyngitis and tonsillitis at the time of the attack. In the intervals between attacks the tonsils showed no enlargement, but were always much enlarged at the time of the attack. In both cases the tonsils were removed and were found to be filled with purulent deposits throughout their substance. Neither child has had a subsequent attack of either variety during the year which has elapsed since the tonsils were removed.

It is of interest in this connection that Sedgwick has observed in a number of children that the removal of adenoids has been followed by cessation of attacks of cyclic vomiting. It seems possible that in these cases the adenoid tissue harbored some infectious agent.

The treatment of these cases of obscure acetone body acidosis is obviously unsatisfactory, since we know so little of their true nature or of the causative agencies. Abundant water should be given, and if not taken by mouth should be given subcutaneously or by intraperitoneal injection. The presence and degree of acidosis should be accurately determined by means of the carbon dioxid tension of the alveolar air or, preferably, by estimation of the plasma bicarbonate. On the basis of these tests sufficient sodium bicarbonate should be given to correct the acidosis. It may be given by mouth, subcutaneously, or intravenously, according to the degree to which the alkali

reserve is impoverished. The tonsillitis and pharyngitis should be treated by the usual measures.

The features of importance of the type of disturbance which I have described may be summarized as follows: There is a type of severe toxic disturbance in infants and children which is accompanied by a marked increase in the acetone bodies in the blood and a marked increase in the elimination of acetone bodies in the urine. This may be due to an increased production of acetone bodies, to a diminished destruction of the amounts of these substances produced in a normal metabolism, or to a combination of both. Mild or moderate acidosis results. The increase in the acetone bodies is not due to starvation, but is probably due to the effect of some toxic agent on metabolism. Fever is always present, and mild or moderate tonsillitis and pharyngitis are frequent. There is a tendency for the attack to recur and for children in the same family to be affected. It seems probable that there is some relationship between these obscure toxic conditions and cyclic vomiting.

CLINIC OF DR. JOSEPHINE B. NEAL

WILLARD PARKER HOSPITAL

EPIDEMIC MENINGITIS[1]

Salient Features in the Diagnosis and Treatment of Different Types of Epidemic Meningitis. Differential Diagnosis. Important Sequelæ. Serum Therapy. Late Administration. Necessity of Prolonged Administration. Epidemic Meningitis in Infants. Types of Serum Reaction. Importance of Fehling's Reduction. Diagnosis Where Organisms Cannot be Demonstrated. Intravenous Injection. Autogenous Vaccine.

MENINGITIS is a disease not often seen except in time of epidemic. Consequently, when the general practitioner encounters a case he is often at a loss, first, in establishing the diagnosis, and, second, in conducting treatment. Almost everyone in the profession is aware that the chief therapeutic weapon is antimeningitis serum, but many are not aware that there is considerable difficulty to be encountered in administering this serum, much more so, in fact, than with diphtheria antitoxin. This being so, it is advisable to have the serum administered by someone trained in this special work and one who is also particularly experienced in confirming the diagnosis already tentatively established by the clinical signs. Consequently, the chief problem that confronts the attending physician is one of diagnosis, and the following cases have been selected with a view to rendering this problem a little less difficult by setting forth the salient features exhibited by these patients suffering from epidemic meningitis. These few cases have been selected from over 400 studied in the past eight years in connection with the work on

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meningitis for the Research Laboratory of the Department of Health, because they bring out points of especial interest and value in arriving at the true nature of the picture that confronts one brought, perhaps for the first time, face to face with a serious condition that can, nevertheless, in most instances be successfully handled.

The first case is presented to show the possibility of brain abscess occurring as a complication in meningitis, and to point out the value of the reduction of Fehling in the examination of the spinal fluids.

CASE I.—S. K., six years of age. The illness began on March 10, 1915, with pain in the ear and nausea. On the following day the patient was admitted to a hospital, with severe headache, pain in the neck and eyes, photophobia, loss of appetite, and constipation. Temperature 102.3° F., pulse 130, respiration 44. There was stiffness and retraction of the neck, a Kernig, and hyperesthesia; 30 c.c. of cloudy fluid were withdrawn at once. On the 12th of March, when I first saw the patient, her condition was very much the same, but, in addition, a macular eruption was noted and also the presence of MacEwen's sign. The knee-jerks were normal. Examination of the eyes was resisted, but a day or two later it was observed that a hypopyon of the left eye was present. Temperature 100° F., pulse 144, respiration 36; 25 c.c. of cloudy fluid were removed and 20 c.c. of antimeningitis serum injected. This fluid showed a great increase in cells, 95 per cent. polymorphonuclears, a few Gram-negative diplococci, mostly intracellular, a + + + albumin and globulin, and an absence of glucose. A pure culture of meningococci grew at the end of seventy-two hours.

On March 13th the condition was not so good. Temperature was 102° F. and the pulse was very weak; 20 c.c. of fluid were withdrawn and 15 c.c. of serum injected. This fluid gave findings similar to the preceding, except that it was sterile.

On March 14th the general condition was somewhat better; 35 c.c. of fluid were withdrawn and 20 c.c. of serum given. This fluid, like the preceding, was sterile, though a few organisms were seen in the smear.

On March 15th the patient was somewhat weaker, the pulse being imperceptible at times; 25 c.c. of fluid were withdrawn and 20 c.c. of serum injected. This showed again a pure culture of meningococci.

On March 16th the condition and pulse were better, though the pulse was still rapid; 40 c.c. of cloudy fluid were withdrawn and 20 c.c. of serum given. This fluid showed a few organisms in the smear, but no growth.

On March 17th the condition was better; 40 c.c. of much clearer fluid were withdrawn and 20 c.c. of serum given; also 500,000,000 of an autogenous vaccine were given, as the organisms had been persisting in the fluid. This fluid showed one colony of meningococci and, for the first time, a slight reduction of Fehling appeared.

On March 18th 40 c.c. of nearly clear fluid were withdrawn and 20 c.c. of serum injected. This fluid was negative by smear and culture; the percentage of polymorphonuclears had dropped to 80 per cent., and there was a good reduction of Fehling.

On March 19th, 20th, and 21st the patient's condition was so much improved that no puncture was indicated. She became rational; at intervals previously she had been delirious. Her temperature ranged from 99° to 101° F. and her pulse became slower, from 84 to 126, and of better quality.

On March 22d, as the temperature remained above normal and she was suffering from headache, a lumbar puncture was done and 40 c.c. of nearly clear fluid removed and 10 c.c. of serum injected. In addition, 750,000,000 of vaccine were then given. This fluid was sterile and showed considerable progress toward normal, the cells being only slightly increased, the albumin and globulin much less than in the preceding fluid, and a prompt reduction of Fehling.

On March 23d an urticarial rash appeared, and on the 24th 1,000,000 of vaccine were given. The temperature ran higher (up to 103.6° F.) on this day, beginning at 8 A. M. before the vaccine had been given. On the 25th the temperature was still elevated, around 103° F., and the patient was drowsy; 50 c.c. of clear fluid were withdrawn, but no serum given. The fluid had

been nearly normal. The failure to improve, therefore, was not due to the persistence of the meningitis.

March 26th patient drowsy, temperature 101° to 102.6° F. March 27th difficulty in swallowing, decided twitching on right side of face; temperature 100.4° to 104° F. March 28th legs drawn up and movement resisted; unable to swallow; continual movement of left arm; temperature 101° to 103.2° F.

March 27th condition about the same; 50 c.c. of clear fluid, practically normal; only a slight increase in albumin and globulin.

March 30th and 31st and April 1st condition continued about the same. On April 2d the condition was worse and 30 c.c. of slightly blood-tinged fluid were withdrawn.

April 3d, 4th, 5th, and 6th the pulse and general condition were better, except that on April 4th she was unable to swallow for a time. Temperature on these days ran from 98.8° to 102.6° F., the average being around 100° F. On April 7th the condition became worse, pulse was very weak, and the temperature ran higher, to 103.6° F.

On April 8th, 9th, 10th, and 11th the condition improved somewhat. On the 12th 40 c.c. of clear, normal fluid were withdrawn. Then the temperature began rising, reaching 106.4° F., pulse 144, respiration 40. On the following days the temperature continued to run high, reaching 106° F. on April 13th and 14th, 107° F. on the 15th, 108° F. on the 16th, and 108° F. on the 19th. On the last day she died, showing marked emaciation and contractures. An autopsy was performed and showed behind the fissure of Rolando in the right side a large abscess with evidence of extensive hemorrhage around it and in it. Smears from this abscess showed no organisms. The meninges were practically normal.

In one other case that I saw only once in consultation a brain abscess was discovered at autopsy. The history of this case has been duplicated in the essential details by at least three others, in my experience, where autopsies could not be obtained. In these cases the spinal fluid became sterile. In one instance it became clear and nearly normal in character, in one case it remained cloudy and failed to reduce Fehling, and in one case

it became yellowish, with a very high albumin and globulin content, suggesting a hemorrhagic condition and reducing Fehling to some extent. These cases all showed more marked signs of improvement than did the case presented here, and a favorable outcome was anticipated. Lumbar punctures performed after they became worse continued to yield sterile fluids. In all these cases marked and rapid emaciation occurred toward the end. In two instances there were unusually severe convulsions. Strumpell in 1889 was the first, I believe, to point out that brain abscess may arise in the course of meningitis, and he cited the history of 3 cases, apparently idiopathic, that had been preceded by meningitis. Fortunately, it seems to be a rather infrequent occurrence.

The presence or absence of glucose, as shown by the presence or absence of Fehling, has been commented upon in discussing this case. It has been our experience that the progress toward recovery usually runs parallel with the return of the power to reduce Fehling. Of course, glucose is present in normal spinal fluid. It becomes greatly diminished or lost at the height of the disease in all but the mildest cases of meningitis. As improvement occurs it gradually returns, though it frequently does not reach normal before the lumbar punctures are stopped. In certain cases that run a prolonged course the reduction of Fehling does not return even with a favorable outcome. In these instances the fluid is usually yellowish in color and shows a very high albumin and globulin content. Of course, not all cases recover in which the reduction returns. It naturally does not apply, for instance, to cases like the one described where the patient dies of a complication, not of the meningitis. But with the exceptions to which practically all rules, especially those relating to medicine, are subject, this holds very well. Not much has been written about it, and yet it is a very simple test to perform, and will serve as an index to treatment where it is not possible to have the spinal fluid cultured. Equal parts of Fehling and spinal fluid should be used and the degree of reduction should not be read for about an hour. A normal reduction taking place quickly is marked + + + (three plus).

The next case is presented to show the difficulties often encountered in diagnosing cases of epidemic meningitis, especially those of long standing. It also illustrates the fact that, even though instituted late, the serum treatment is of great value. Occasion is taken to discuss some of the most important sequelæ of epidemic meningitis.

CASE II.—M. M., twenty-one months old. Seen first June 5, 1916. There was a history of illness extending over two months, beginning with an abscess from broken-down glands on the left side of the neck. After this there was a discharge from the right ear. Then there were symptoms of some pulmonary condition, evidently not a frank pneumonia. Later there was iritis and hypopyon of the right eye, together with rather indefinite meningeal symptoms. The child was sent to a hospital for diseases of the eye and some general improvement followed. A lumbar puncture was not done. The eye condition was not greatly improved. She had been home from the hospital only a short time when she again became worse and vomited very persistently, so that no nourishment had been retained and she had refused food for twenty-four to thirty-six hours. When I saw her she was stuporous. There was slight stiffness of the neck and a marked MacEwen. The knee-jerks were not obtained. The left pupil was dilated and did not react to light. The right was contracted and the tension of the eyeball markedly diminished. Pulse 140, regular, and temperature 99° F.; it had been running a rather low, irregular course. The child was greatly emaciated.

The diagnosis of this case presented several difficulties. Clinically, it looked like a tuberculous meningitis: the low irregular temperature, stuporous condition, the late vomiting (which is usually early in epidemic meningitis), the emaciation, and the slight but well-marked stiffness of the neck. Generally a case of epidemic meningitis that has been running on for some time shows retraction of the neck. Furthermore, there was the history of broken-down cervical glands and an indefinite infection of the lungs, all strongly suggesting a tuberculous condition. On the other hand, there was the history of

hypopyon, which I had never seen in tuberculous meningitis, but which occurs occasionally in the epidemic form, and the pulse, though rapid, was regular. In tuberculous meningitis the pulse is usually irregular in rate and force. Then, again, the history of a running ear would suggest the possibility of a meningitis of otitic origin, probably caused by a pneumococcus or a streptococcus. A lumbar puncture yielded 35 c.c. of slightly cloudy fluid, and 20 c.c. of antimeningitis serum was immediately injected. This fluid showed a great increase in cells, 95 per cent. polymorphonuclears, a few Gram-negative cocci both intra- and extracellular, a pure culture of meningococci, albumin and globulin ++++, and Fehling 0 + (a normal reduction of Fehling is marked +++).

June 6th: Temperature 100° F., pulse 140. Child had not vomited in the past twenty-four hours and had taken some nourishment; 35 c.c. fluid withdrawn and 20 c.c. injected. The results of the examination of this fluid were similar to the first.

June 7th: Condition about the same; 40 c.c. fluid somewhat clearer, and 20 c.c. serum. This fluid was similar to the other except that the reduction of Fehling was still more diminished. The organisms failed to grow, though they were still present in the smear.

June 8th, 9th, 10th, and 11th: Lumbar puncture was done each day, amount of fluid removed varying from 30 to 40 c.c., and 20 c.c. of serum were injected each time. The fluids were all free from meningococci both by smear and culture. The number of cells gradually decreased and so did the percentage of polymorphonuclears. The reduction of Fehling continued to be greatly diminished until the 10th, when it became ++, and on the 11th it was +++, or normal. The general condition improved slowly; nourishment was very well taken and there was no vomiting. The dilatation of the left pupil, which had been very marked at first, gradually became less.

June 30th: As the child had been restless and had not slept well for two or three nights, a puncture was done to relieve pressure; 35 c.c. clear fluid were removed and no serum was given. This fluid still showed considerable increase in the albu-

min and globulin, though the number of cells was only slightly increased, 95 mononuclears, and the reduction of Fehling was practically normal. Although the meningitis had cleared up and the child took nourishment well, the nutrition did not improve and she remained greatly emaciated.

Early in July, on account of the continued emaciation, the patient was sent to a hospital for babies to see if the nutrition could not be improved by suitable feeding. Although she did improve somewhat during her stay in the hospital, when seen at home in August she was still greatly undernourished and had an excessive growth of hair on the extensor surfaces of the arms and legs and on the back. Soon after this, however, she began to improve, gained in weight and strength, and began to walk and talk again. As the nutrition improved the excessive growth of hair disappeared.

When seen in January, 1917, she was a very healthy, well-developed child, intelligent and playful, and seemed quite normal in every way except for the loss of sight in her right eye. The right eyeball was atrophied.

This excessive growth of hair, associated with the profound malnutrition, I have seen in one other case that came under my observation late and gave a history strongly suggesting an attack of meningitis. Netter and Debre are the only workers in whose writings I have seen this condition mentioned. They make no suggestion as to the cause of the condition. It may very well be due to some disturbance of the internal secretion resulting from the long-continued meningitis.

Loss of eyesight, due to an iridochoroiditis of which the hypopyon is a symptom, and deafness are possibly the two most serious sequelæ of meningitis. The loss of eyesight is usually limited to one eye. In one instance only have I seen it occur in both eyes. In 410 cases it has occurred ten times. There is a difference of opinion as to the manner in which the infection reaches the eye; according to some it is borne by the blood, while others think it proceeds by extension along the pia arachnoid of the nerves. Councilman, Mallory, and Wright hold the latter opinion and back it up by autopsy findings. The loss

of eyesight is usually complete and the eye becomes smaller. In one instance only did the inflammation subside without resulting in so much destruction, and at the end of a year there was some vision present.

Deafness is a more common sequelæ. It usually affects both ears and is complete and permanent. Ordinarily it comes on during the height of the illness, and in young children may not be observed until convalescence. In one instance it appeared two or three weeks after the treatment had stopped, and in one case there was a partial deafness in the acute stage, which cleared up almost wholly during convalescence, but reappeared suddenly and became absolute about nine months later, when the child was hit on the back of the neck by a falling slab. The blow was not very severe, not sufficiently so, apparently, to cause serious injury, and the deafness does not seem to have been due primarily to it. Perhaps it was instrumental in starting up some latent inflammatory process. The auditory nerve, according to Councilman, Mallory, and Wright, in cases of deafness shows exudative and degenerative changes due to the extension of the inflammatory process from the meninges. This process may extend and involve the labyrinth and even the organ of Corti. The fibrinopurulent exudate is soon organized into an osteoid connective tissue. Those rare cases of deafness that clear up are probably due to a serous infiltration of the labyrinth and nerve which readily subsides. In 410 cases deafness has occurred in 20.

The next case is presented to show the possibility of diagnosis and treatment in a very young child. It must be borne in mind that before the introduction of serum therapy the mortality in children under a year old was nearly 100 per cent.

Case III.—J. P., fourteen weeks old, first seen April 4, 1918. Illness began March 27th suddenly, with fever and restlessness. There had been no vomiting, but the stools had been greenish. When seen there was a bulging fontanel, the child lay with head retracted, and was very restless. There was a temperature of 101.2° F. Most cases of meningitis in children under a year old do not show stiffness of the neck or retraction, but usually

if the child is held on the side there is a tendency for the head to fall back. The Kernig is usually of no value, as the child is irritable and resists the gentlest handling, and the reflexes are difficult to elicit. The fontanel usually bulges, but an absence of tension does not absolutely rule out an increased pressure of fluid. Netter says: "In times of epidemic think of meningitis and do a lumbar puncture on every child sick without apparent cause." A lumbar puncture was done and 20 c.c. of cloudy fluid removed showed a great increase in cells, 95 per cent. polymorphonuclears, a ++++ albumin and globulin, an absence of the reduction of Fehling, Gram-negative diplococci both intra- and extracellular, and a pure culture of meningococci; 20 c.c. of serum were injected at the time the puncture was done.

On April 5th and 6th 25 and 20 c.c. of fluid were withdrawn respectively and 20 c.c. of serum injected each time. Both these fluids showed no meningococci by smear or culture.

April 7th: As the case seemed much improved and the fluid was sterile by a forty-eight-hour culture, no puncture was done. The case continued to do very well and made an uneventful recovery.

Certain writers have a table of dosage of serum for children neatly arranged according to age. It has been my experience that in young infants as well as in older people the amount of serum should be regulated by the amount of fluid withdrawn and the ease with which it runs in by gravity, and I never hesitate to give 20 c.c. even to young infants. This is in accordance with the practice of most of those who have had much experience with young children. Indeed, some recommend doses of 30 c.c. or even more.

The next case is presented to show the necessity of persisting with the serum treatment even when the case yields very slowly to it:

Case IV.—J. G., twenty-four years old. Illness began September 8, 1917, suddenly, with headache, restlessness, chills, and fever. Seen September 9th. Moderate stiffness of the neck and Kernig. Pupils slightly contracted, equal, and react-

ing to light. Knee-jerks equal and slightly increased. Irritable. Pulse 84, regular. Temperature 104° F.; 35 c.c. very cloudy fluid, 20 c.c. serum. This fluid showed a great increase in cells, 95 per cent. polymorphonuclears, ++++ albumin and gloublin, and an absence of the reduction of Fehling. There were extracellular Gram diplococci in the smear, but the culture was sterile.

September 10th: 50 c.c. of cloudy fluid; 20 c.c. of serum. This fluid was similar to the first, except that it yielded a pure culture of meningococci.

September 11th, 12th, 13th, 14th, and 15th: Lumbar punctures done daily, 20 to 50 c.c. of fluid being removed, and 20 to 35 c.c. of serum injected. The fluid gradually became clearer and the reduction of Fehling returned, but the cultures remained positive until the fluid of the 15th, which was sterile. It was also nearly clear and gave a practically normal reduction of Fehling. The patient's general condition was good and the temperature was normal.

September 19th: Another puncture was done, as there had been fever and headache during the night; 45 c.c. of slightly cloudy fluid were withdrawn and 35 c.c. of serum injected. Although three or four colonies grew at the end of forty-eight hours, no more punctures were done until the 24th. Some physicians believe that after a fairly large amount of serum has been given the patient can take care of a few organisms if left to his own devices. While this is not in accordance with our views, it seemed best to try out this theory in this particular instance. The patient's condition continued to be good and the temperature remained normal until the 24th, when he became worse and had a temperature of 103° F.

September 24th, 26th, 27th, and 28th: Punctures were done daily, 40 to 45 c.c. of fluid being removed and 20 to 35 c.c. of serum being given. These fluids all yielded cultures of meningococci except the one on the 28th, and the reduction of Fehling had gradually disappeared; 500,000,000 autogenous vaccine were given.

September 29th, 30th, October 1st, 3d, 4th, 5th, 6th, 7th:

Lumbar punctures were done daily and serum given. These fluids showed positive cultures up to the 6th and 7th, when they were sterile and showed a fairly good reduction of Fehling. Meantime the vaccine had been given every two or three days and increased to 4,000,000,000. The patient's condition seemed remarkably good for so long an illness. He seldom had fever except for a little while during the reaction from the serum. He was occasionally delirious at night.

October 9th: Another puncture was done and 30 c.c. of nearly clear fluid removed and 20 c.c. serum given. One colony finally grew from this fluid; 6,000,000,000 vaccine were given. No other puncture was done until the 13th and the condition was very good. On the night of the 12th, however, he had temperature; 35 c.c. slightly turbid fluid were withdrawn and 30 c.c. administered; 8,000,000,000 of vaccine were given. This vaccine apparently caused some reaction, as there was more fever, headache, and restlessness than ordinarily followed the administration of serum alone. This fluid showed some growth, but the fluids of the 14th, 16th, 17th, and 18th were sterile. On the 15th 10,000,000,000 vaccine were given, which was also apparently followed by some reaction. These last four fluids were rather less in amount than the earlier ones, running from 5 to 15 c.c. They showed a fair reduction of Fehling, the last two practically normal. Although the patient was considerably emaciated, he made a rapid and complete recovery.

This case illustrates very well the necessity of continuing the serum treatment even if a good many injections are necessary. In all, twenty-eight doses of serum were given, and it would seem that the recovery was due to the persistence in administering it and perhaps to the additional action of the vaccine, for on the two or three occasions when the serum was stopped, because the patient's condition and the sterility of the fluid or the very small number of organisms seemed to warrant it, he promptly got worse. That is, he was given the opportunity two or three times to go on to recovery by himself without the serum and he was not equal to it. In several instances in my experience it has been necessary to give from twelve to twenty injections in cases that

have finally recovered, but this is, up to the present, the largest number. One of the causes of lack of success in the serum treatment is the failure to persist in cases like this.

Where the organisms persist after five or six injections, or where lapses occur, it is well to use an autogenous vaccine. It is often difficult, as in the present case, to tell whether or not it does any good, especially if the serum is continued with it. It is to be observed, however, that after the reaction following the 8,000,000,000 administered on the 13th the fluid was sterile. In an adult it is quite safe to begin with a dose of 1,000,000,000 and to continue with 2,000,000,000, 4,000,000,000, 6,000,000,000, 8,000,000,000, and even 10,000,000,000 if a reaction does not occur earlier.

The next case is an illustration of those in which symptoms of sepsis predominate rather than those of meningitis, and where reaction to the serum is so severe that its use cannot be continued. The various forms of serum reaction are discussed.

Case V.—M. D., three years of age, onset October 30th, with vomiting, irritability, and fever. A purpuric rash appeared on the body and the joints of the left wrist and thumb became swollen and tender. On November 3d a blood-culture yielded meningococci. A septic temperature was running, ranging from 98° to 105° F. Although there were only slight signs of meningitis, a lumbar puncture was done November 5th and 30 c.c. of bloody fluid were withdrawn, which the physician doing the puncture believed to be hemorrhagic, and about 30 c.c. of serum were given by gravity. The child immediately became cyanotic and pulseless. Artificial respiration, massage of the heart, stimulants, and oxygen were given and the condition improved. The spinal fluid showed no meningococci. The amount of blood interfered with the other tests. The child's evident intolerance of serum made it inadvisable to try the intravenous administration, although she continued to run a temperature, but not so septic as the first three or four days. The rash was fading by November 7th, although the joints continued to be swollen and painful. On the 9th the face began to be swollen and examination of the urine showed an acute nephritis. On the 14th a blotchy rash,

evidently a serum rash, appeared on the body and lasted for several days. The temperature from the 11th to the 14th ran a lesser course, around 100° F., but on the 15th it shot up again to

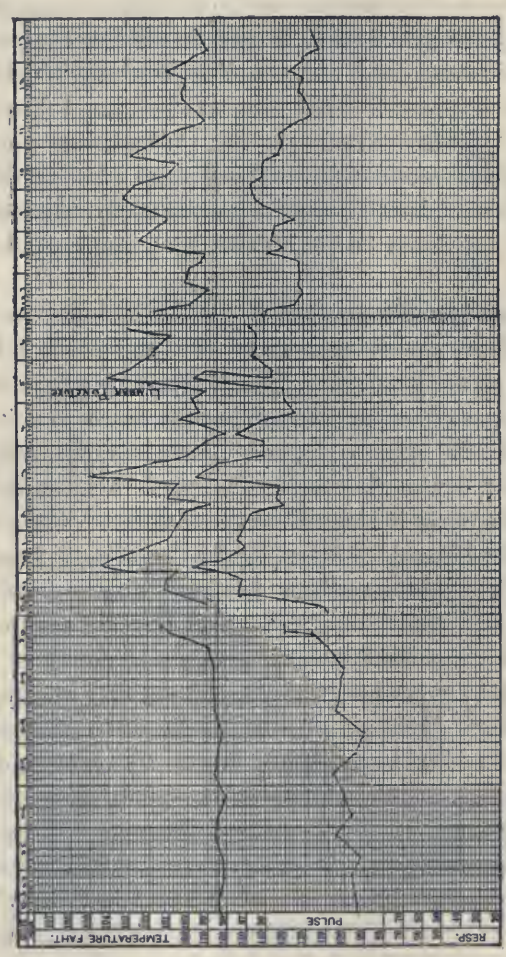


Fig. 42.—Chart of Case V.

105° F. The child seemed very sick and vomited a good deal on the 16th and morning of the 17th; this might have been due to the nephritis or the serum reaction. The temperature began running lower on the 17th and continued to run a lesser course

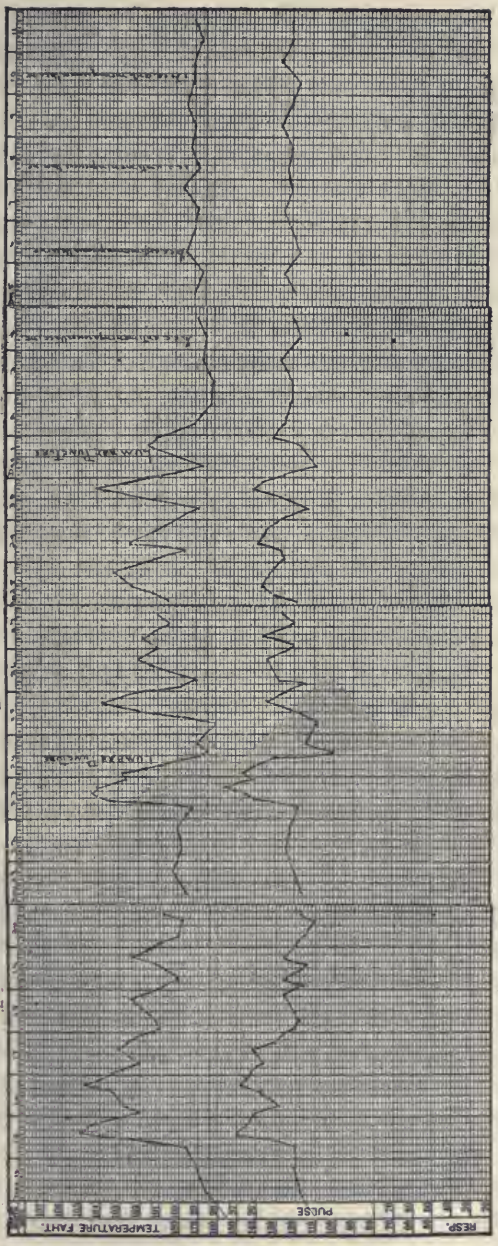


Fig. 43.—Chart of Case V (Continued).

until the 23d, when it went up to 104.2° F. A second lumbar puncture was done on the 24th, although there were no well-marked signs of a meningitis; 30 c.c. of nearly clear fluid were withdrawn, but no serum was given. This fluid showed a great increase in cells, 85 per cent. polymorphonuclears, a + + albumin and globulin, a + + + Fehling, and no meningococci by smear or culture. This might very well represent fluid of a recovered case of meningitis. The patient continued to run a septic temperature, and on December 1st a third lumbar puncture was done; 30 c.c. of distinctly cloudy fluid were withdrawn and 20 c.c. of serum were again given, in the hope that there might be no reaction this time, and, at any rate, desperate measures seemed warranted. A severe reaction followed, however, and no more attempts were made to give serum, although this fluid showed meningococci both by smear and culture. On the following day, December 2d, however, the temperature dropped to normal. An autogenous vaccine was prepared and its use was begun on the 4th with 250,000. The vaccine was given every other day for five days, running it up to 1,500,000,000. The temperature continued to be practically normal and recovery took place. Urine examination on December 11th showed that the nephritis had cleared up.

This case is interesting from a number of points of view. In the first place, the symptoms of sepsis were much more prominent than those of meningitis. A good deal of attention is being paid to cases of this sort at present because they have occurred in a larger proportion than usual in some of the army camps. Indeed, Herrick goes so far as to say that the meningitis is a secondary complication of the early sepsis. This seems to me an extreme view. No doubt there is an early sepsis in many, perhaps in most, cases of meningitis, but so is there in pneumonia and typhoid. But it is the pneumonitis and intestinal ulcers that we have to consider, not the sepsis. So it is, I think, in the great majority of cases of meningitis, though, of course, in certain outbreaks there is a larger than ordinary number of cases where the sepsis predominates. In the cases appearing in New York City during the past eight years certainly the number of septic cases has been comparatively few. Of course, cases of this sort should be given

serum intravenously. Herrick recommends 50 to 100 c.c., repeated in eight to twelve hours. The intraspinal injections should not be neglected if the spinal fluid shows that the meninges have been involved. This point of not neglecting the intraspinal injections cannot be too strongly emphasized, as many physicians have seemed to gather the impression that perhaps the intravenous method is preferable and, indeed, may supplant the intraspinal administration. I have recently seen cases that had been treated by intramuscular injections for three weeks, as some difficulty in lumbar puncture had been encountered. The patient promptly responded to the intraspinal treatment. The serum could not be used in this case either intravenously or intraspinally on account of the patient's intolerance. A vaccine was finally used, and it probably would have been well had we used it earlier. Its value is difficult to estimate, as the temperature dropped on December 2d, following the intraspinal injection of serum, and was still normal on the 4th, when the vaccine was begun. Its use may have prevented a recurrence of symptoms.

This case was complicated by the acute nephritis. Whether this was due to the disease or the serum it is impossible to say. Another point of interest is the type of serum reaction which occurred. As it is not always easy to keep in mind the effects of serum apart from the curative action, a brief discussion of them may be of interest. They may be divided into three groups: (1) In most cases the administration of serum is followed in four to eight hours by the reaction, that consists in a rise of temperature of 1 to 3 degrees, increased headache and restlessness, and pains in the legs. If this is at all severe the pain and restlessness should be controlled by sedatives. (2) Serum sickness in a varying percentage of cases develops in from eight to twelve days; it may be as late as twenty-one days. There is usually an urticarial eruption with intense itching, often accompanied by a rise in temperature and an increase in the meningeal symptoms and occasionally by vomiting. Sometimes swelling of the joints occurs. In one case the joints of the forearm and hand and of the leg and foot became so painful that the patient was unable to move, and thought he was para-

lyzed. The serum reaction seems to be little influenced by the quantity of serum given, and from the time of its appearance is caused by the first dose. Indeed, one of the severest reactions I have ever seen followed a single dose. In cases that relapse and require the readministration of serum at an interval of several days after the first series of injections have been given, we have on several occasions observed an urticarial eruption appearing in twenty-four to forty-eight hours. This same accelerated reaction also occurs with other sera. The rash of either the usual or the accelerated reaction may come out every day for several days and be accompanied by fever. (3) There may be a true anaphylactic reaction to the serum, which, fortunately, is very rare. In only this one case has there been so much hypersensitiveness that it was impossible to use it.

The next case is introduced to illustrate a not unusual type where, although the clinical symptoms and the response to serum point to an epidemic meningitis, the organisms cannot be demonstrated; the examination of the spinal fluid, apart from the bacteriologic side, however, confirming the diagnosis of an acute meningitis.

Case VI.—M. R., twenty-three years of age. Sudden onset on the afternoon of August 16, 1917, with headache, fever, vomiting, and wild delirium. First seen twenty-four hours later; vomiting, headache, and delirium continued. Combined efforts of three people necessary to restrain her while puncture was done. There was stiffness of the neck and a marked Kernig. Pupils reacted to light. The knee-jerks were absent. Pulse, 72 regular. Temperature 103° F.; 35 c.c. of cloudy fluid were obtained and 20 c.c. of serum injected. This fluid showed a great increase in cells, 95 per cent. polymorphonuclears, ++++ albumin and globulin, and a + Fehling; but no organisms could be demonstrated either by smear or culture. About twelve hours elapsed, however, between the withdrawal of the fluid and its examination.

August 18th: The condition had improved remarkably. She was rational, the vomiting had stopped, and the temperature was 100.4° F.; 45 c.c. of slightly cloudy fluid were obtained and

20 c.c. of serum injected. This fluid showed about the same findings as the preceding one, except that the number of cells was diminished and the reduction of Fehling was ++ 1.

August 19th: The temperature was 99.6° F. in the morning, but fell to normal during the day; 35 c.c. of nearly clear fluid were withdrawn and 20 c.c. of serum injected. This showed fewer cells and a normal reduction of Fehling. The albumin and globulin were still greatly increased. As the fluids had been sterile and the clinical symptoms had entirely subsided, no more punctures were done. She made an uneventful convalescence. An urticarial rash appeared on the 25th and lasted three days.

Of course, the diagnosis in this case was not proved bacteriologically, but clinically it was a case of an acute meningitis. The spinal fluid showed an active, purulent, inflammatory reaction in the greatly increased cells, with the 95 per cent. polymorphonucleosis, the high albumin and globulin content, and the diminished glucose as shown by the poor reduction of Fehling. Moreover, the case responded promptly to the use of antimengitis serum. In view of these facts, and also of the fact that all other forms of purulent meningitis—pneumococcic, streptococcic, staphylococcic, and influenzal—are so uniformly fatal, there seems little doubt as to the true diagnosis. We have had one case of streptococcic meningitis recover, but all other cases of purulent meningitis due to the organisms mentioned above have died.

Confusion in diagnosis may arise in a case of so-called meningitis sympathetica, a condition occurring where there is inflammation near the meninges. Several cases of this kind are described by I. Strauss. He characterizes the fluids as showing an increase in pressure and in the albumin and globulin content and cellular elements, the cells being usually polymorphonuclears. The fluids are also sterile. He makes no comment as to the sugar content except in one case, where he says it was increased. In two cases of this type that I have seen the reduction of Fehling has been normal. A diminution in the reduction of Fehling may, therefore, be of help in ruling out this condition, as well

as the failure to find any evidence of a focus of infection in the vicinity of the meninges.

In stating that I believe the diagnosis of epidemic meningitis to be probably correct in cases like M. R. where there are symptoms of an acute meningitis, a favorable response to antimeningitis serum, a fluid showing an increase in the polymorphonuclears and in the albumin and globulin, and a diminished reduction of Fehling, even though meningococci cannot be demonstrated, I by no means wish to imply that I believe an epidemic meningitis exists without the presence of meningococci. It is easy to see, however, that it is possible, if the organisms are few in number, for them to elude our attempts at demonstration even in an early case like this. Of course, the quantity of material used on the slides and on the culture-media is relatively small, and the organisms may not be in that particular quantity. The cultures sometimes show only one, two, or three colonies even in positive cases, and it is easy to understand that another portion of that same material might have contained an insufficient number of organisms to produce a colony. (In subculturing meningococci it is necessary to carry over a larger amount of material than is the case with most organisms.) Moreover, the meningococcus undergoes spontaneous autolysis, and if the spinal fluid cannot be examined within a short time, a few hours, the chances of demonstrating the organism become less. In this particular case the fluid was not examined for over twelve hours after it was withdrawn, and this may very readily account for the smear being negative and the culture sterile. In cases that have been running on for some time when first seen the organisms may have disappeared due to the action of the patient's own antibodies.

The important point about this is that patients of this type should receive the benefit of antimeningitis serum. If, as sometimes happens, after two or three sterile fluids some other organism makes its appearance, no harm will have been done for two reasons: first, the antimeningitis serum, while of no benefit, will not have been injurious; and second, not being able to foresee the organism that was about to appear, we could

not have used its specific immune serum earlier. Moreover, the treatment of all other forms of meningitis is highly unsatisfactory.

This question has been taken up somewhat at length, but it can hardly be too much emphasized that on doing a lumbar puncture a cloudy fluid should be followed immediately by the injection of antimeningitis serum; and that the use of the serum should be continued, even though the meningococci cannot be demonstrated, until the patient is greatly improved or until some other organism has made its appearance. This rule, naturally, will not apply to the cases of meningitis sympathetica where the cloudy fluid is due to an inflammatory focus in the neighborhood of the meninges.

CLINIC OF DR. BURRILL B. CROHN

MOUNT SINAI HOSPITAL

CLINICAL CONDITIONS CHARACTERIZED BY OBSTRUCTIVE JAUNDICE[1]

Difficulties of Diagnosis. Aid Rendered by Duodenal Tube. Diseases Showing Common Symptom of Obstructive Jaundice and Methods of Diagnosis with Analysis of Cases: Calculi in Choledochus; Carcinoma in Terminal Bile and Pancreatic Ducts; Sarcoma Involving Head of Pancreas; Chronic Intralobular Pancreatitis. Value to Accurate Diagnosis of Ascertaining Patency of Biliary and Pancreatic Systems and Functional Activity of Pancreas.

WE will devote ourselves today to the consideration of a series of cases possessing in common the clinical feature of obstructive jaundice. This type of case is one in which the exact diagnosis has at all times been associated with many difficulties and pitfalls. In fact, in no field of abdominal conditions have more surprises and unexpected findings been encountered at operation or at autopsy. To differentiate a benign obstruction from a malignant one has always been a matter of difficulty. We apply our keenest clinical insight, we make use of all our best laboratory data, and yet even then we are often puzzled to determine the exact etiologic factor in our case of obstructive icterus.

Of recent years we have noted the introduction of the duodenal tube as an aid in the diagnosis of such conditions. In this clinic I shall attempt to demonstrate the mode of applying the chemical data obtained by means of the tube to the clinical

[1] Impromptu clinical demontration delivered in the wards of Mount Sinai Hospital, service of Dr. Emanuel Libman, May, 1918.

facts in hand, and shall show to what extent this data can be applied in the interpretation of the clinical phenomena.

The first patient is a man forty-eight years old. During childhood he suffered from a severe attack of pharyngeal diphtheria; he also had measles. He denies all venereal disease. He married twenty years ago; his wife has given birth to four healthy children and has had no miscarraiges. He has never, to his knowledge, had typhoid. He is very mildly alcoholic, drinking an occasional glass of beer. Ten years ago he suffered from an attack of acute abdominal pain, localized, as he says, in "the pit of the stomach." The pain was cramp-like, lasted for two hours, and was relieved only by a hypodermic injection of morphin. From time to time since then he has experienced similar though less severe attacks of pain. Since the original attack he has suffered from "heartburn" one to two hours after eating. Meat in particular gave rise to this sensation. He experienced relief when taking small doses of bicarbonate of soda, and violent belching usually denoted the end of the attack. He vomited only once, the vomitus consisting of food recently eaten and containing no blood. He has never noted blood in the stools nor tarry feces.

During the fortnight previous to his appearance for treatment he was seized almost daily with several attacks of abdominal cramps lasting, on an average, fifteen minutes. Twelve days before I saw him he noticed that his skin was becoming yellow. The depth of this coloration gradually increased until it was a dark yellow shade. His stools became clay colored in appearance, though he was somewhat constipated. He also lost 8 pounds in weight.

Physical examination revealed a well-nourished, rather obese man, weighing 190 pounds and of average height. As you see him today after his operation he is not jaundiced, but previously his skin was a deep icteric hue, golden yellow in shade. On exposing his abdomen you will see a long transverse scar across the upper quadrants. On abdominal examination made before operation one could palpate a slightly enlarged liver edge extending two fingerbreadths below the free border of the ribs,

and an area of slight tenderness extending from the right of the right rectus muscle to halfway between the ensiform cartilage and the umbilicus. There was also tenderness over Murphy's point, though the gall-bladder was not palpable. Temperature was normal; pulse 84. Blood examination showed a low white cell count (7500 per cubic millimeter), with a polymorphonuclear count of 80 per cent.

From what form of jaundice was this man suffering? What was the etiologic factor in his illness? To all intents and purposes the patient was suffering from an obstruction of the common bile-duct, probably from a calculus which had worked its way down through the cystic duct and was now lodged somewhere in the common duct. Was the common duct partially occluded, or was it completely obstructed, and, if the latter, was the pancreatic duct also involved?

At this point we turn to the evidence obtained by chemical examination. The duodenal tube was passed one night at 10 o'clock, and the next morning the contents of the duodenum were obtained. They had a faintly golden yellow coloration and were clear. Bile was evidently entering the duodenum, although in diminished amounts. Chemical examination of the fluid showed the three pancreatic ferments—amylase, lipase, and trypsin—to be present in normal quantities.

Microscopic and chemical examinations of the stool gave no evidence of abnormality. There were no excessive amounts of muscle-fibers or neutral fat.

To summarize: Here was a middle-aged, portly man, who for ten years had irregular attacks of abdominal colic and symptoms of gastric hyperacidity. After a more severe attack he became jaundiced within two weeks, the jaundice increasing rapidly and deepening, and the patient losing weight. The duodenal contents showed a partial obstruction of the choledochus, no obstruction of the pancreatic duct, and a perfectly functioning pancreas. There was, then, apparently a partial obstruction of the common bile-duct above the head of the pancreas and above the diverticulum of Vater. This we know to be caused most often by a gall-stone lodged in the common duct.

The patient was operated upon, and three irregular prismatic gall-stones were found in the choledochus just above the point where the duct enters and passes through the head of the pancreas. The stones were firmly implanted in the duct. The pancreas was palpated throughout and felt apparently normal. The stones were successfully removed through an incision in the first portion of the common duct; a cholecystectomy was then performed and drainage established. Recovery was uneventful.

The obstruction caused by a calculus or by calculi in the common duct is very rarely a complete one. Only once have I seen a case where two large, firmly impacted calculi caused a complete obstruction and a disappearance of the bile from the duodenal contents. A new growth at this point, which has become superficial within the intestinal lumen and has begun to undergo degenerative ulceration, may simulate a partial obstruction of this kind; but in that case we have other guides, as will be demonstrated in one of the subsequent cases. As a rule, a new growth gives a picture of complete obstruction of one or both ducts, and a stone that of a partial obstruction of the common duct. Pancreatic disease, as an etiologic factor, seemed unlikely in the face of the chemical data.

As a contrast to this case, let us study for a few minutes the history of the following patient: This man, forty-eight years old, was admitted to the hospital for observation, complaining that for eight days he had been becoming progressively more jaundiced. He recalled no symptoms prior to this. He had not lost weight, had no pain nor gastric disturbance, but was obstinately constipated. He abstained from the use of alcohol and denied venereal disease.

Physical examination showed a fairly well-nourished man, decidedly jaundiced, with a pale saffron hue of icterus. There was no evidence of loss of weight. The liver was palpable one fingerbreadth below the free border of the ribs on the right side. The edge of the liver was sharp and smooth and slightly tender. The gall-bladder was not palpable.

During the first two weeks of his stay in the hospital the

patient's temperature was slightly elevated, reaching at evening a maximum of 101° F. The later course was afebrile.

Blood count: leukocytes 6400; polymorphonuclear leukocytes 59 per cent.; lymphocytes 31 per cent.; eosinophils 9 to 12 per cent.

The patient remained under observation for three weeks. During this time the jaundice gradually disappeared, temperature became normal, and all symptoms cleared up. The duodenal contents obtained during this time showed abundant, ropy, mucoid bile and active pancreatic ferments. Evidently both ducts were patent.

The case was regarded as one of probable catarrhal jaundice, and the man was discharged from the hospital under that assumption. Only one point in the evidence favored the theory of new growth; on several occasions chemical blood had been found in the stools (guaiac test), but this was finally attributed to hemorrhoids which were present.

This patient left the hospital at his own request, feeling quite well. Seven weeks afterward he was readmitted, stating that he had been free of symptoms for the first four weeks, at the end of which time he noted a gradual reappearance of the icterus. His stools became clay colored, urine dark brown, and he began to experience epigastric pains.

On re-examination, the liver was found to be palpable three fingerbreadths below the free border of the ribs. The liver edge was slightly irregular and tender; the gall-bladder was palpable as a smooth, globular, tender mass. Temperature was now of a septic type, reaching 103° to 104° F. at night and dropping to normal in the morning. A definite leukocytosis was now present and blood was chemically present in the stool. We again obtained duodenal contents for examination; this time they showed a complete absence of bile; pancreatic ferments were present, though in diminished strength. Operation was decided upon and performed, and a small round tumor was felt occupying the site of the papilla of Vater. The tumor was the size of a 25-cent piece, infiltrated, and very firm. The common bile-duct was enormously dilated to the thickness of a man's little finger.

The head of the pancreas was partially infiltrated with tumor tissue. The liver was enlarged and studded on its surface with numerous miliary and larger abscesses. Drainage of the gall-bladder was the only surgical procedure attempted.

In this case we were dealing throughout with a carcinoma arising in the papilla of Vater and invading the exit of the common bile-duct and the pancreatic ducts, as well as the head of the pancreas. We had opportunity of seeing the development of this case at two different stages. At the first stage we deduce from our findings that the neoplasm, though still at an early stage of its growth, had begun to ulcerate on its intestinal surface, freeing both the involved ducts. The patient was definitely jaundiced on his first admission to the hospital, yet the jaundice rapidly diminished and disappeared and the duodenal contents showed both ducts patent. The only sign of an ulcerating neoplasm was the blood in the stool. On the second admission to the hospital we saw the case in a more advanced stage. The neoplasm had extended and had involved in its tenacious hold both the common bile-duct and the pancreatic duct. This was evidenced by the complete absence of bile and the partial diminution in the strength of the pancreatic secretion. We now had two more links in our chain of evidence: a definite leukocytosis and temperature of the so-called septic type. We were dealing with an infectious cholangitis arising in the sloughing neoplasm and ascending the bile-ducts and invading the biliary radicle in the liver itself. That blood was still present in the feces was another point in favor of an ulcerating neoplasm.

Thus the chain of evidence was complete, and the findings at the operating table of the tumor, the enormous dilatation of the choledochus, the globular, tense gall-bladder, and the neoplastic invasion of the head of the pancreas confirmed the previous deductions.

This case demonstrates the two rôles in which a tumor of the terminal bile or pancreatic ducts, or of the papilla of Vater, appears. Most commonly, such a tumor causes complete occlusion of one or both of these ducts. The best evidence of

this is the complete absence from the duodenal contents of bile, or of bile and pancreatic ferments. Less commonly we see such tumors in the stage of necrosis, with sloughing of the neoplasm on the intestinal surface. If this occurs, a partial re-establishment of the flow of these secretions may be noted in the duodenal contents. Ulceration and sloughing in the tumor is further proved by the presence of fever, leukocytosis, and melena, these symptoms furnishing the evidence of a secondary ascending cholangitis.

As a further demonstration of the points just illustrated I should like to quote from an interesting case observed by Dr. N. E. Brill, and published by him in full in the New York State Medical Journal in 1912. I had the privilege of studying the duodenal contents of this case. The patient was a young man, eighteen years old, who was admitted to the medical service of Dr. Brill at Mount Sinai Hospital. He had suffered for three and a half years with sharp attacks of abdominal cramps, vomiting of greenish material, and constipation. Six months before his admission to the ward his appendix had been removed under the impression that chronic inflammation of that organ was causing the symptoms. Soon after the operation the symptoms returned and two months later he became jaundiced. He had chills and fever every day and lost rapidly in weight, color, and strength.

In the hospital the patient was weak, drowsy, apathetic, and pale. He was markedly jaundiced. No abdominal mass was palpable. His blood examination revealed a condition of severe secondary anemia. His hemoglobin was estimated at 22 per cent. (Sahli, corrected), R. B. C. 1,500,000, W. B. C. 13,000, polymorphonuclear leukocytes 85 per cent. Feces contained blood chemically, but no excess of muscle-fibers or neutral fat.

The patient remained under observation for three months, gradually emaciating, running a continuously abnormal though irregular temperature course, and showing a progressive anemia, until he died. He was deeply jaundiced throughout the period of treatment.

During his stay in the hospital duodenal contents were obtained on three occasions. The first specimen of fluid so obtained showed a complete absence of bile and pancreatic ferments. A month later a second specimen demonstrated again an absence of biliary secretion, but traces of pancreatic ferments. Still another month later the duodenal secretion contained traces of bile and the pancreatic ferments were now abundantly present.

At the autopsy, which was performed by Dr. E. Libman, a friable rounded-celled sarcoma was seen invading the duodenal wall and involving the head of the pancreas. Both biliary and pancreatic duct systems showed enormous dilatation as a result of this terminal obstruction. Secondary necrosis and ulceration, however, had in part liberated these ducts, so that the obstruction at death was no longer complete.

This case is in many ways similar to the foregoing one. The former patient was seen for the first time when the ducts were open; on later examination the ducts were found closed. The latter patient was first seen at the stage of complete occlusion of the ducts. Later, the soft friable sarcoma ulcerated and a partial patency of the ducts was re-established. These two cases give a fair impression of the course and of the means of diagnosis of tumors involving the terminal bile and pancreatic ducts. Yet one correction to this impression must be made before a rule can be established. In by far the largest percentage of cases tumors in this area cause complete obstruction of one and frequently of both ducts. In my experience, when one duct alone is involved it has always been the common bile-duct. The complete occlusion may not be permanent, but is present in every case at some time in its course, and is most easily and only truly demonstrated by an examination of the duodenal contents.

Benign stenosis, in contradistinction to the above, gives, as a rule of thumb, only partial occlusion throughout its course. The exceptions to this rule are few. In passing it should be noted that stricture of the common bile-duct, which occasionally follows upon incision and drainage of the choledochus,

often gives the picture of complete bile occlusion. These cases are very easy to distinguish.

We may now proceed to review a type of disease which is also characterized by an obstructive jaundice, but which differs from the above two types. I shall read to you the clinical report and the account of the postmortem findings of the following case.

This is the history of a man thirty-seven years of age; his previous history was of little interset; he denied luetic infection; had no serious illnesses; his habits were good, he smoked a few cigarettes and abstained entirely from alcohol. He was married and had two healthy children. Seven weeks before his admission to the hospital he was suddenly seized with an attack of abdominal cramps, situated in the epigastric region and radiating to the umbilicus; the cramps lasted for about one hour. After that he noticed a gradually increasing jaundice, pale colored feces, and a tendency to diarrhea, having two or three motions daily. There was a marked loss of weight after the onset of his illness, but he did not know the exact amount. He was admitted to the medical service of Dr. N. E. Brill, in whose ward I had the privilege of seeing the patient.

Physical examination revealed a poorly nourished individual whose skin and scleræ were of decided icteric hue. The liver was enlarged, the free edge of the right lobe being palpable three fingerbreadths below the free border of the ribs, the upper border of the right lobe percussing to the fourth interspace in the midclavicular line. A globular, slightly tender mass in the right hypochondrium was evidently the distended gall-bladder; otherwise the abdominal examination was without points of interest.

The patient was kept under observation for several weeks in an attempt to establish a diagnoiss. Clinically, this was difficult, as many factors entered into consideration. The onset of the illness with an attack of abdominal pain suggested cholelithiasis with a calculus in the common bile-duct. On the other hand, the almost painless course, the progressive icterus, and the rapid loss of weight suggested a new growth. There were

no grounds for considering syphilis; the Wassermann reaction was negative. At no time during the period of observation was the temperature above normal; no leukocytosis was present, and there was no blood in the feces. A diagnosis of chronic pancreatitis was considered among the possibilities, though its rarity as a well-defined clinical condition causing obstructive jaundice spoke rather against it.

Duodenal contents were obtained and analyzed. A rather milky, slightly yellow secretion was withdrawn. Bile was present only faintly. On careful chemical analysis all three pancreatic ferments were found to be markedly diminished. It is interesting to correlate the duodenal secretion findings with the clinical data. A calculus impacted even firmly in the lower end of the common bile duct or in the diverticulum of Vater has never produced so marked an obstruction of the biliary outflow (always remembering the single instance where the rule was broken and the obstruction was a complete one). But apart from this, we have never seen a calculus produce so marked a diminution of pancreatic secretion. It is questionable whether a calculus lying in the diverticulum of Vater could sufficiently block both these excretory canals so as to cause the chemical picture seen here. Of course, a small calculus firmly impacted in the papilla of Vater could act as a complete plug, and so restrain the excretions of these two systems from entering the duodenum. But the practical fact remains that in our experience with a very large series of cases calculi do not give rise to so marked an obstruction as to cause both bile and pancreatic secretions almost to disappear from the intestine. It seems much more reasonable to suppose that the diminished pancreatic ferments were an indication of a pathologic process taking place in the pancreas, that is, a sclerosing pancreatitis, and that the common bile-duct in its final course through the head of the pancreas had become involved in the inflammatory process and its lumen markedly diminished.

We have, however, not yet excluded the possibility of a new growth at the head of the pancreas. We have seen from our previous two cases that a neoplasm, which involves the papilla

and is in the stage of necrosis, can give just such a picture in the duodenal secretion. But we lack the three clinical concomitants which are present in such a condition, namely, fever, leukocytosis, and melena. These three factors were entirely absent in this case.

In an attempt to substantiate the diagnosis of chronic pancreatitis the stools were carefully examined and found to be rather large and clay colored, and microscopic examination showed a large excess of undigested meat fibers and neutral fat globules. While the feces were not yet typical of advanced pancreatic disease, similar to the bulky, oily motions first described by Richard Bright, yet there was sufficient excess of undigested meat fibers and neutral fat globules definitely to denote a pathologic process in the pancreas.

Metabolism studies were performed to determine whether pancreatic disease had advanced to the point of interfering with intestinal absorption. The patient was put upon a mixed diet containing on an average 22 grams of nitrogen and 71.3 grams of fat per day. The feces were collected for three days, dried, and analyzed. It was shown that this man excreted 16.4 per cent. of his nitrogen intake and 34.7 per cent. of his fat intake. A person in normal health excretes from the alimentary canal only 4 to 6 per cent. of nitrogen and 12 to 16 per cent. of the fat of the diet. Evidently this patient had a definite disturbance of his ability to absorb food; that is, he had a steatorrhea and an azotorrhea. This, in the absence of intestinal disease, is pathognomonic of pancreatic disturbance.

At the operation performed upon this patient the upper abdomen was thoroughly explored. The gall-bladder was found to be tense and distended. The wall was incised and the biliary ducts probed for their entire length. Neither calculus nor new growth was found. The head of the pancreas was indurated and exceedingly firm. Duodenotomy was performed to make sure that no neoplasm of the papilla of Vater had been overlooked, but none was found. Fine probes passed from above freely entered the enlarged choledochus, but met an impassable obstruction at the head of the pancreas. Attempts to

enter the ducts from the intestinal surface were also of no avail. A cholecystostomy was performed and the abdominal incision closed. The patient died in shock two days later.

At necropsy a chronic intralobular pancreatitis, mainly involving the head of the pancreas, was established as the cause of the symptoms. No other pathologic condition was discovered.

The foregoing case presents many points of unusual interest. It is an instance of a primary, chronic intra-acinar pancreatitis, a disease characterized by a proliferation of inflammatory connective tissue which invades and destroys the parenchyma of the gland and disorganizes the individual pancreatic lobules. It differs from chronic interlobular pancreatitis in that in the interlobular form the invading inflammatory tissue involves the periphery of the lobule, while the intralobular or intra-acinar form attacks the intimate secretory apparatus of the gland.

It is particularly the intralobular form of chronic pancreatitis in which one notes a diminution of the gland ferments in the duodenal fluid. Conversely, diminished ferments in the duodenal secretion denote a pathologic process in the pancreas. A new growth involving and obstructing the terminal pancreatic duct or the papilla of Vater acts differently. It usually obstructs the duct completely; then there is a complete absence of the ferments. Or, if ulceration has taken place in the tumor, the normal ferments pour through. The usual tumor is the small adenocarcinoma originating in and involving the papilla of Vater. This tumor does not destroy much of the pancreatic tissue. Hence, if the pancreatic ferments are at all present, they appear in undiminished strength.

Diminution in the strength of the ferments occurs in chronic intralobular pancreatitis, or in neoplasm involving and destroying the parenchyma of the gland. It is when the secretory acini are invaded and destroyed that the pancreatic secretion is disturbed. In acute pancreatitis the ferments are almost entirely absent. Duodenal contents in which bile is abundant but ferments diminished means always parenchymatous pancreatic disease, usually chronic inflammation.

Nitrogen and fat absorption is dependent not so much on the preservation of a copious and active external secretion of the pancreas as it is dependent upon the functional activity of the pancreatic parenchyma *per se*. Mere mechanical obstruction of the pancreatic duct system is not associated with disturbance of alimentary resorption. This has been repeatedly demonstrated in metabolism studies of cases of neoplastic obstruction of the ducts. Following the suggestion of Lombroso, who conducted careful experiments upon dogs, we have come to understand that it is the state of preservation of the parenchyma of the gland that controls the absorption of food from the intestine. A disease process that disorganizes a large part of the secretory acini causes large losses of fat and nitrogen from the intestine. If only a part, small but healthy, is preserved, absorption may remain good. This maintenance of functional activity in the gland probably depends upon an internal secretion just as it does in the thyroid or parathyroid or pituitary gland.

The internal secretion of the pancreas is as important as the more obviously essential external secretion, and is the regulator of the absorptive activities of the intestine.

Summary.—We have attempted to analyze in a series of cases of obstructive jaundice the individual clinical symptoms, and have essayed to arrive at a proper diagnosis before operation. In so doing we have utilized the assistance offered by analysis of the duodenal contents and of the stools, and have correlated the clinical facts with the laboratory data. By ascertaining the condition of patency of both biliary and pancreatic systems and by determining the functional activity of the pancreas we have had valuable additional data upon which to construct a more accurate diagnostic opinion. Full details of the technical procedure of duodenal contents examination and its clinical application can be obtained in the following articles:

Experiences with Duodénal and Stool Ferments in Health and Disease, Eighth International Congress of Applied Chemistry, vol. xix, page 73.

Chemical Examination of Duodenal Contents as a Means of Diagnosis in Conditions of Jaundice, Journal of the American Medical Association, 1915, lxiv, page 565.

New Growths Involving the Terminal Bile and Pancreatic Ducts, Journal of the American Medical Association, 1914, cxlviii, page 839.

Studies in Pancreatic Disease, Archives of Internal Medicine, 1915, xv, page 581.

CLINIC OF DR. S. PHILIP GOODHART

MONTEFIORE HOSPITAL

THE PRIMARY MYOPATHIES AND THEIR ENDOCRINE RELATIONSHIP

Clinical Findings. Familial Tendency. Distribution of Muscles Affected. Changes in Electric Reactions. Different Types of Muscular Dystrophy; Characteristic Features of Each. Earliest Manifestations. Pathologic Processes in Muscles. Changes in Other Tissues. Illustrative Cases. Discussion of Endocrine Relationship and Possibilities of Therapy.

IN choosing the subject for today's lecture I have made a careful selection of cases for demonstration with a view to impressing upon you not only the clinical features of muscular dystrophy as we see it in these advanced cases, but of the possibility of preventing such an outcome by early endocrine and other therapy.

Analysis of the Disease.—The term "idiopathic muscular atrophy" has long been used to designate a group of cases which, although for a time erroneously allied in pathology with muscle atrophies due to spinal cord lesions, are now known to be quite independent and different from such atrophies. The group of cases we have under consideration today is known by the comprehensive designation "muscular dystrophy," and belong to the class of primary myopathies. The first true cases of this type, probably, were described by Charles Bell in 1830.

Clinically, they are characterized by atrophy and pseudohypertrophy of certain groups of muscles, but their grouping differs from that occurring in progressive muscular atrophy. The latter disease, analogous symptomatically to chronic poliomyelitis, is due to degeneration of the anterior horn cells of the

cord. In the pathology of the dystrophies lesions of the cerebral and peripheral nervous system are never discovered as part of the definite findings.

The disease is essentially a familial abiotrophic manifestation occurring in several members of the same family, of the same or of a subsequent generation. The disease seems to be transmitted through the maternal influence. The disease is more apt to develop in the male members of a family than in the female. You will see the great predominance of male patients in the cases presented to you today, and also the frequency with which brothers are affected. The female members of a family themselves usually escape, although they may transmit the disease to their sons. Gowers reports a case of transmission by the female side to the third generation.

The general obtrusive clinical features of dystrophies, as distinguished from the progressive muscular atrophies of central nervous origin, are the distinctive distribution of muscles affected and the apparent enlargement of some of the diseased muscles. Furthermore, in these diseased muscles the changes in electric reaction are such as result from quantitative loss of muscle tissue, and hence are purely quantitative; while in progressive muscular atrophy qualitative changes, with change of reaction formula, occur. In the dystrophies, the axial, girdle, pelvic, and trunk muscles are affected, while in spinal atrophies the peripheral or distal groups, the extremities, are primarily involved. Fibrillary twitchings are absent in the muscles affected in muscular dystrophies, since the trophic center, the nerve-cell of the anterior horn, is intact.

Several varieties of muscular dystrophy are recognized according to the onset of the disease, with especial reference to the muscles affected. The cases I am presenting to you illustrate these several types. It should be remembered, however, that, in reality, these groups merge into each other, and it is most common to find mixed types. Three types are commonly recognized: the facioscapulohumeral type, or Landouzy-Dejerine type, or the *atrophie musculaire progressive de l'enfance* of Duchenne; the juvenile form of Erb, and the pseudohypertrophic

type of Duchenne. In the facioscapulohumeral type the atrophy begins in the muscles of the face, and may be confined to the face symmetrically for some time before other muscles are involved. This type usually begins in early life, most often in infancy. The atrophic musculature soon gives the face the typical expression called "the myopathic face." Three of the patients whom I shall show you today (Cases V, VI, and VII) illustrate this. The expression appears apathetic, the forehead is not wrinkled, the nasolabial folds are absent, the lips appear large, thickened, the mouth pointed or snout-like on the lateral aspect. The mouth cannot be elevated, as a result of which the so-called transverse smile is seen in repose. Puckering of the lips is no longer possible. The eyes cannot be completely closed. The affection of the orbicularis palpebrarum and oris, so often the first muscles attacked, gives the peculiar spiritual facial expression, the so-called *facies beat.* The expression of the patient may suggest mental defect, but the intellect is not impaired, as you may see upon interrogation of the patients to be presented today.

The next groups of muscles to be affected are usually those of the upper limbs, especially about the shoulders and upper arms, the shoulder girdle groups. This sequence of muscle involvement explains why this is called the facioscapulohumeral type. The supra- and infraspinati and subscapularis usually escape. In the pure form there is only atrophy and no hypertrophy. In this type, as in that described by Erb as the juvenile type of progressive muscular dystrophy, the sexes are about equally affected. The muscles affected most early are the serratus magnus, the trapezius, and the rhomboidei. The winged scapulæ, so often seen, are due to atrophy of the rhomboidei and serrati (Case I). The involvement of the lower limbs may occur at approximately the same time, but it is usually later than that of the upper. Invariably the proximal groups alone are at first affected, and it is only very late, if at all, that the distal ones become involved.

The trunk muscles, including those of the abdomen, may be early involved, with a resulting lordosis so often observed in this

disease, and as is shown in three of the cases presented. That the osseous changes are not due to mechanical conditions I shall point out to you later. It is principally the atrophy of the trunk muscles and extensors of the hips and knees that makes these patients "climb up upon themselves," so to speak, when assuming the upright from a prone position, as will be illustrated to you by our patients, for I shall ask those affected in this way to lie upon their backs, and you will observe the characteristic manner in which they reach the upright position, first kneeling, then raising one knee, then with the hand upon the knee working upward in a manner as though really climbing upon their own leg and thigh and trunk. This, with the characteristic waddling gait and lordotic pose, makes the clinical picture at once clear to the observer. In attempting to arise the patient rotates the whole body by means of pressure with the arms to the ground, thus getting over on one side; he then flexes the hips, drawing up the knees under the abdomen, and is able, by rotating the trunk around the knees as a lever, "to get on all fours"; he then extends his knees by throwing his head down between the arms; with the knees extended, he keeps the feet fixed and then works back on his hands, places one hand and then the other from the ground to the knee, and he now extends his hip by transferring each hand in turn to a higher level on the thigh, and then shifts his center of gravity backward by suddenly throwing the shoulders backward.

It will be observed further that the deformity of the spine is peculiar and changes its curves in the standing and sitting postures. When the patient stands one sees marked lordosis with lumbar concavity and a high degree of compensatory convexity of the upper dorsal and lower cervical vertebræ. In the sitting position these curves disappear; they are transformed to a single kyphotic curve with concavity forward.

In some of our cases you will observe contractures of some muscles giving rise to forms of talipes, especially talipes equinus, due to secondary contractures of the hypertrophied calf muscles which contain an abnormal quantity of fibrous connective tissue. In the two forms, the juvenile type of Erb and the Landouzy-

Dejerine type when pure, there are no hypertrophies; although a peculiar pseudo-enlargement, really due at least in part to adjacent atrophy, is often seen in the central portion, especially of the biceps, deltoids, and calf muscles.

The juvenile or scapulohumeral type was first described by Erb of Heidelberg. This does not differ from the Landouzy-Dejerine type except that it often appears later in life and the face is not involved. In the juvenile form the biceps, triceps, and supinator longus are the first usually affected; soon the pectoralis major and latissimus dorsi become involved, and the serratus magnus is often paralyzed, though the deltoids and supra- and infraspinati are frequently intact, thus allowing the scapulæ to stand out prominently at their posterior border and lower angle when the patient extends his arms straight out in front of him (Case I). The trapezius is often affected in its entire length, including the superior clavicular portion, as a result of which the normal slope of the neck to the shoulders is changed, giving a characteristic attitude of myopathies. In some cases the sternocleidomastoids are affected, in fact, often being congenitally absent in the aberrant type of myopathy associated with muscular dystrophy, and this condition is known as amyotonia atrophica, as illustrated by the case of the woman we will examine today (Case II).

The true pseudohypertrophic form of dystrophy is essentially a disease of childhood. It is familial and boys are more often affected than girls. Cases V, VI, VII, IX, which I shall demonstrate today, are examples. Certain muscles are, as a rule, apparently enlarged throughout the course of the disease. When the patients are seen early the calves, hips, and buttocks appear unusually large, although the arm and trunk muscles may be of normal size and contour. As was evidenced in our cases, the first sign is usually some difficulty in walking. The child is observed to stumble frequently and climbing stairs is difficult. In contrast with the weakness there is an apparent enlargement of the muscle groups. There is often atrophy of some and hypertrophy of other muscles. The muscles which tend to show enlargement of tissue are the calf muscles, the gastrocnemius and

soleus. They assume a peculiar shape, the posterior border of the calf appearing elliptic with prominent convexity over the middle of the calf, and the muscle tissue, or rather its modification, has a most peculiar hard feel, as you can easily verify by examining the patients before you. From the weakness of these muscles, as demonstrated by the patients' inability to stand upon their toes, as well as by the peculiar feel and shape, you can see that the hypertrophy is not a true hypertrophy of muscle tissue. The process is indeed pathologic, as we shall more clearly see later. The pathologic process resulting in additional tissue and appearing as pseudohypertrophy is further seen in the glutei. The flexors and adductors of the hip and flexors of the knee are usually atrophic. Of course, the apparently large muscles eventually lose their shape and fulness, but the peculiar hard feel and relative enlargement can be demonstrated throughout the course of the disease. The erector spinæ is sometimes hypertrophied, but in my personal experience it has usually been atrophic.

Of the shoulder girdle group, the deltoid has especially proved to be the seat of early pseudohypertrophy, as, to a lesser extent, have the supra- and infraspinati. As we may observe in our cases, the deltoid long remains as a peculiar hard mass. In the forearm, as we see here, the triceps tends to hypertrophy, showing a convex outline, while the biceps is practically gone. Further, among the atrophic muscles are the lower portion of the pectoralis major and the latissimus dorsi. The loss of pectoralis major we will demonstrate by having the patient put both arms out horizontally in front of his body; upon pressing the hands together the upper portion of the muscle alone is seen to contract.

Generally speaking, the clinical picture of progressive muscular dystrophy is so characteristic that one should have no difficulty in making the diagnosis, even in very early cases. The conspicuous features are characteristic muscle group involvement; pseudohypertrophy and weakness; atrophy; quantitative changes in electric reactions; diminution of deep reflexes corresponding to the amount of tissue lost; and absence of all sensory changes and of fibrillary twitching. Furthermore, we

may add the association of other tissues involved, especially bones, hair, skin, pigment and fat deposits, and characteristic metabolic findings. The osseous changes, as demonstrated by roentgenographic examination, are seemingly constant.

The pathologic changes in the muscles are interesting. The muscles are found, postmortem, either to be in an advanced stage of atrophy; or, if they have been enlarged, they are diminished to about the normal size. In color the muscle is paler than normal. In extreme cases, on cross-section in the gross, they appear as a fatty tumor without trace of muscle tissue. Microscopically, the muscle-fibers, when the process is not too far advanced, are found diminished in size and number, and on cross-section are found to have lost their normal contour. They may be separated by fat cells and bands of fibrous tissue. The relative amount of fat and fibrous tissue differs in the various muscles. In the early process the deposition of fat in masses suggests fatty deposits in other parts of the body.

The so-called pseudohypertrophy of certain muscle groups is characteristic of this disease. Most observers speak of the hypertrophy as, in part, a true muscle-fiber enlargement similar to physiologic hypertrophy. This is an error. A true hypertrophy of muscle consists in an increase in the number of normal muscle-fibers and in the bulk of sarcoplasm present in the muscle. These are not the findings in muscular dystrophy. Physiologically hypertrophied muscle does not show the splitting and loss of angular contour of the fibers, the proliferation of connective tissue and fat deposit shown by the tissue from muscular atrophy cases. Spiller thought that the many nuclei present in muscle from dystrophy cases indicated true growth, but nevertheless admitted that the other histologic abnormalities were the same as originally described by Erb of Heidelburg, and thus of a degenerative nature. On the whole, the process is one of degeneration. Its cause we will speak of further on after the demonstration of our cases.

The following cases are typical of the several types with their variable features, which I shall demonstrate in each, showing the cases in the order of their severity:

Case I, a boy eleven years of age, had one sister who was also affected with muscular dystrophy. Four years previous to his admission to this hospital he was operated upon for cataracts of both eyes. His present illness began at four years of age, with distinct progressive weakness in all the muscles of the body. There is at present general muscular wasting and weakness, with the exception of the calf muscles, which are in a condition of pseudohypertrophy. When lying on the floor the patient assumes the erect position in a characteristic manner by rising on one knee, extending the other leg, pulling himself up on that, and then dragging up the other leg. There is a myotonic reaction in the tongue, thenar and hypothenar eminences, and the deep reflexes are but feebly elicited. A partial myotonic reaction is found in this and in the following case. The muscles of the tongue, thenar and hypothenar eminences are, therefore, affected. The myotonic action to be observed in these two cases can be demonstrated by percussion over the muscles thus: When I tap the muscle over the thenar eminence you will notice a slow, tonic, protracted contraction follows. The muscle stands out like a tumor; again, upon repeating the mechanical stimulus, it shows depressions and ridges at the points struck. The mechanical excitability of the nerves is not increased. Upon percussing the protruded tongue you observe the same myotonic phenomenon. When walking the patient has a characteristic steppage gait. On appropriate movements

Fig. 44.—Case I. Winged scapulæ. Characteristic pose in assuming upright position.

there are typical winged scapulæ. The facies is of the myopathic type and there is very little fatty tissue. You will observe the abnormal growth of hair on the extensor surfaces of the upper extremities just above and below the elbow. Marked cyanosis is present in the peripheral portions of all four extremities and is only slightly influenced by posture, the hands remaining distinctly cyanosed even when elevated. The Wassermann reaction is negative. The roentgenographic examination of the skull and long bones was essentially negative.

Case II is a woman, forty-three years of age. This case is really a mixed type, an amyotonia atrophica, combined with progressive muscular dystrophy. One brother died in his forty-fifth year of progressive muscular dystrophy. In our patient the disease began in the thirty-eighth year, with weakness in the lower extremities and also in the upper, but in lesser degree. Motor paresis in the neck muscles developed later. At present the facies is characteristic of primary myopathy; motor power is markedly diminished; there is intense cyanosis of the feet; the volume of musculature is lost throughout the body, with far greater relative diminution of function; the gait is slow and hesitating, with broad base; there is wasting of muscles of neck and shoulders; the sternocleidomastoids are atrophic; there is myotonic reaction in muscles of tongue and right thenar and hypothenar eminences. The patient is unable to raise herself on the chair without assistance, and she has a low monotonous speech. The roentgenogram shows small spots of bone absorption scattered throughout the upper portion of the cranium. There is a faint shadow, about 5 by 7 mm., situated slightly

Fig. 45.—Case II. Only case of muscular dystrophy in a female in the series associated with myotonia atrophica.

above and 3.5 cm. posterior to the tip of the posterior clinoid process. This shadow suggests the pineal gland.

Case III, a man forty-two years of age, has two brothers known to have muscular dystrophy. The patient lived under unhygienic conditions, his work exposing him to metallic dust of lead, brass, antimony, etc. The onset, which began in his

Fig. 46.—Case III. Exophthalmos, hypertrophy of calves, and deposits of fat.

twenty-sixth year, was gradual; there was progressive weakness in the right arm, extending to the left, then involving both lower extremities. There is marked exophthalmos and dilated pupils. The patient cannot voluntarily assume a sitting posture, but maintains it when assisted. The head is flexed and rotated to the right. There is marked atrophy of the sternocleidomastoids, trapezii, and muscles of the forearm. The deep

reflexes are absent; the knee-jerks diminished. The characteristics exhibited in this case are contrasted pseudohypertrophy and weakness of function of the calf muscles. The muscle tissue seems to be replaced almost entirely by fat. The Wassermann reaction is negative. The roentgenograms show very marked bone rarefaction in the skull, evidently in the tabula interna, simulating strongly the convolutions of the brain. The extremities show moderate diffuse bone rarefaction, somewhat more marked in the lower. In both tibiæ there is evidence of very advanced localized bone absorption running in the form of two narrow strips throughout the upper half of the diaphysis, suggesting cavity formation.

Fig. 47.—Case IV. Wasp-like contour of body.

Case IV, a man forty-eight years of age, has two brothers who are affected with primary myopathy. The onset of this patient's illness was in his thirtieth year, with weakness in both upper and lower extremities. He is able to move about only in a wheel-chair, and has difficulty in assuming a sitting position. There is flexion of both thighs and knees and contraction of the hamstring muscles. Extension of legs is limited to 130 degrees. His body is of wasp-like contour, facies myopathic, and the calf muscles are weak and have the characteristic sclerotic feel. Pseudohypertrophy is present. There is marked wasting of the general musculature. The deep reflexes cannot be elicited because of atrophy. Electric examination shows quantitative changes in the affected muscles. The skin is cold and clammy, the feet cold and cyanotic, and there are

trophic changes in the nails. The pulse is slow and of low tension. Roentgenograms show several small irregular spots of bone absorption scattered throughout the parietals and frontals. There is an irregular shadow, about 0.5 to 1 cm. on the level of and 4 cm. posterior to the tip of the posterior clinoid process (pineal body?). Evidence of bone absorption of the posterior

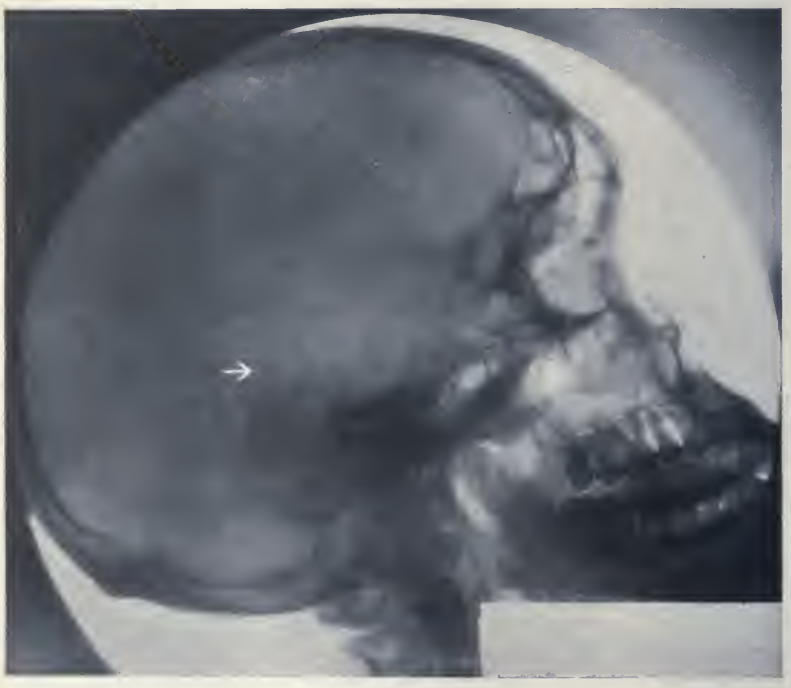


Fig. 48.—Case IV. Shadow of pineal body, small irregular spots of bone absorption throughout parietal and frontal bones.

clinoid process is present. The sella turcica is not enlarged. There is marked diffuse bone atrophy in the upper extremities. In some places differentiation between compacta and spongiosa has entirely disappeared. There is a moderate amount of diffuse atrophy of all bones of the lower extremity, including tarsal bones.

Case V, a young man nineteen years of age, has two brothers

who are affected with progressive muscular dystrophy. The patient has an extra digit on all four extremities (congenital deformity). When he was three years of age he began to exhibit progressive weakness, in the order named, of the lower extremities, upper extremities, back, and facial musculature. The calf muscles show the usual pseudohypertrophy with the characteristic sclerotic feel. The whole skeletal structure ap-

Fig. 49.—Case V. Myopathic facies. Unusual growth of hair about the hips. Marked diminution in length of long bones. Whole skeletal structure stunted. Underdevelopment of genitalia.

pears stunted; the long bones between the knees and ankles are abnormally short, and there is a peculiar distribution of the hirsutes, the individual hairs being abnormally long, especially about the groins and thigh anteriorly. The roentgenograms show underdevelopment of the long bones and absorption of osseous tissue.

Case VI, eighteen years of age, has a very significant family

history. His father is an epileptic, he has two brothers affected with muscular dystrophy, and one maternal aunt is insane. The onset in this patient began in his fifth year with generalized muscular weakness and slowly progressive wasting. The calf muscles show typical pseudohypertrophy, and the muscles, orbicularis oris and palpebrarum, are atrophic. The trunk deformities are in large part due to muscle wasting. The hair is

Fig. 50.—Case VI. Skeletal deformities, myopathic facies, talipes equinus.

strikingly long and abnormally distributed on the body; the scalp hair is very dry and brittle. There are trophic ulcers on the fingers and toes. The roentgenograms show marked, diffuse rarefaction of all bones examined. They are abnormally thin and underdeveloped.

Case VII, a boy fifteen years of age, displays profound muscular weakness with contractures involving almost the entire musculature of the limbs and trunk. The sternocleido-

mastoids are atrophied and there is extreme distortion of the trunk. This case represents an advanced muscular degeneration. The facial muscles on both sides are involved in the typical myophathic loss of function on effort. The exophthal-

Fig. 51.—Case VII. Exophthalmos, myopathic facies, skeletal deformities, extreme muscular atrophy.

mos is emphasized by the partial wasting of the orbicularis palpebrarum. There is marked dryness of the skin on the abdomen and a deposition of brown pigment. The teeth are wide apart and there is macroglossia. The roentgenograms

Fig. 52.—Case VIII. Extreme skeletal deformities, marked general atrophy, peculiar distribution of hair about buttocks and thighs.

show marked underdevelopment and rarefaction of all bones examined, most advanced in the carpus and tarsus.

Case VIII, a young man nineteen years of age, has one brother affected with muscular dystrophy. In his third year our patient's manner of gaining the erect position, typical of

muscular dystrophy, was observed. He was never able to run or to climb stairs. There is marked wasting of all muscles of the body and contractures in the hamstring and calf muscles. The enlargement of the calf muscles and the peculiar sclerotic feel are in contrast to the marked general atrophy elsewhere. The skin is peculiarly dry, with diffuse areas of brownish pigmentation, and a prolific, long hairy growth about the pelvis and thighs. The cyanosis of the lower extremities in the distal

Fig. 53.—Case IX. Hypertrophy of calf muscles, acromegalic features, general massive contour of head and face.

portions is marked and there is a tendency of the soft parts to ulceration. Roentgenograms show atrophy of all bones examined. The lower portions of the ulnæ and radii are abnormally thin from underdevelopment.

Case IX, a boy fourteen years of age, has a family history containing no element relevant to the patient's condition. The initial symptoms bearing on the development of the muscular dystrophy date from his third year. There is a history of gradual

weakness, beginning in the lower extremities, progressively involving the girdle, facial, and shoulder musculature. Pseudohypertrophy and atrophy have finally reached a very high degree. There is also, in part secondary to the marked involvement of the trunk muscles, extensive kyphoscoliosis from the sixth dorsal to the midsacral region. The general massive bony contour of the head and face, and especially the marked prognathic lower maxilla, are decidedly of the acromegalic cast. The sexual development, in contradistinction to the other cases reported,

Fig. 54.—Case IX. Macroglossia.

shows abnormally advanced maturity of growth. There is marked macroglossia, the tongue on protrusion being really huge. There is excessive growth of hair over the entire body. Roentgenographic study of the skeletal structure examined shows the usual underdevelopment of the long bones. Those of the skull, especially the lower jaw, present markedly acromegalic features.

Case X, a boy fourteen years of age, has one brother with muscular dystrophy, but the family history as to nervous, mental, and otherwise hereditary influences is negative. The patient's

illness was first observed when he was seven years of age; the symptoms were weakness of the muscles of the lower extremities. The involvement of the upper extremities began about the age of twelve, that is, some five years following the involvement of the legs. I would call your attention at this point to the frequent observation made in these cases, namely, that the evidence of some motor defect has been that of difficulty in ascending and descending stairs.

Fig. 55.—Marked atrophy. Abnormally long phalanges, skeletal malformation, obliteration of nasolateral folds, characteristic fulness about the mouth.

Our examination of this boy shows a bedridden patient in a recumbent posture. There is present the familiar group involvement affecting the girdle, shoulder, and hip musculature, and peripheral groups remaining comparatively little affected. The electric reactions and deep reflexes again show only quantitative electric reduction, and the reflexes diminished or absent to the extent of the atrophy. You observe a very marked kyphoscoliosis and a general relaxation of the ligaments and skeletal joint structures. The atrophy is extreme. Both lower extremities are permanently flexed at the knee-joints, due to secondary contractures,

of mechanical origin, of the ham-strings. These contractures are not of the character, of course, of spastic changes in the central nervous system. The chest shows marked asymmetry. The lower ribs on the right side are almost in contact with the pelvis so great is the general relaxation and muscular atrophy. There is complete atrophy of the deltoids, biceps, and triceps. Only the muscles of the calves show the relative pseudohypertrophy and

Fig. 56.—Showing underdevelopment of humerus.

the characteristic sclerotic feel. The facies is typically myopathic. The lips appear full and pointed and the facial weakness is evident from the facial appearance and absence of the normal folds and the patient's inability to actively execute the common movements, such as closing the eyes tightly, whistling, blowing, etc. The skeleton presents some characteristic abnormalities, unusual length of long bones, especially the phalanges, and very marked underdevelopment in circumference, as shown

in the roentgenograms. The hair is dry and rough to a remarkable degree, the hair of the head, to the examiner's touch, feel-

Fig. 57.—Characteristic underdevelopment of long bone.

ing like a hard brush. Hirsutes are abundant on the extensor surfaces of the legs.

Our conception of progressive muscular dystrophy has undergone a great change within very recent times. As in the case of

other pathologic manifestations of muscle structure and function, such as myasthenia gravis psuedoparalytica, tetany, myotonia congenita, etc., we are beginning to look upon these phenomena as but part of more general disturbances of the organism with pathologic evidence in other tissues as well. The basis for the more generalized manifestations we now recognize in the pathogenesis of endocrine dysfunction. While admitting the restraint necessary in accepting a great deal that has been claimed for endocrine influence in general, there seems to be no question but the glands of internal secretion, namely, the thyroid, pituitary, gonads, thymus, parathyroids, and adrenals, play a most important etiologic rôle in the production of the disturbance of bodily functions. Certain syndromes and their identification with perverted function of certain endocrine glands are, as you know, definitely established. I need only mention, for example, the group of symptoms associated with pituitary and thyroid dysfunction. In practically every one of the cases of muscular dystrophy before you distinct evidence of endocrine involvement is to be found. We have but to refer to the physical examinations in each case, including the metabolic investigations and roentgenologic findings. Let me refresh your memory for a moment in regard to the symptoms produced by dysfunction of the hypophysis. You will recall that hypopituitarism, occurring before pubescence, manifests itself clinically by a diminution of bodily hair, obesity, underdevelopment of the genitalia, feminine contour of the body in the male, and amenorrhea in the female. If the posterior lobe is especially involved the prominent symptoms are increased sugar tolerance, adiposity, and low blood-pressure. Again, hyperactivity before puberty frequently induces a precocious degree of sexual development, overgrowth of bodily hair, and excessive skeletal growth. Overactivity of the posterior lobe usually induces decreased sugar tolerance and high arterial pressure. Our cases embody some of the important symptoms enumerated.

Since the subject under our consideration today deals particularly with disturbances of muscle tissue and function, let me call your attention to the relation of endocrine activity to that struc-

ture. Data are fast accumulating to show that muscular dystrophies may have their origin in the disturbed activity of the organs of internal secretion. The therapeutic importance of the establishment of this etiology is at once apparent. Indeed, throughout the literature examples are beginning to appear indicating that endocrine therapy has been followed by favorable results in many cases of apparent primary muscle disease. In our series of cases, as in others which have been published, it is impossible to state which one of the several endocrine glands is primarily at fault. In our series roentgenographic studies were made with a view of determining involvement of the pineal gland. In only two cases were we able to find definite shadows which could be ascribed to that gland. That these shadows really represent pathologic conditions in the pineal body is questionable, though some authors, calling attention to the muscular weakness observed in pineal disease and to its probable involvement in some cases, speak of the possible pineal origin of certain cases of muscular dystrophy. On the other hand, the thyroid, the hypophysis, the adrenal, and the gonads are represented in symptoms associated with cases of the primary myopathies. It is not unlikely that the muscular dystrophies, and perhaps other so-called primary myopathies, are really but symptom complexes caused by dysfunction, not of any one, but of various endocrine glands separately or coincidentally affected. We must remember in this connnection that symptoms which represent dysfunction of one of the glands of internal secretion may be identical with symptoms of the disturbance of another of the ductless glands. For example, retardation of growth, defective osseous formation, and adiposity may result from dysfunction of the thyroid, the pituitary, or the gonads.

The clinical and pathologic evidence, and now studies in metabolism as carried on here at the Montefiore Hospital on the cases presented today, point most strongly to endocrine influence. Studies of these cases, with a view toward comparing the results with those found in others of unquestionable endocrine origin, were carried on by Dr. Janney, Mr. Isaacson, and myself, and our findings add data confirmatory to that of other observers, and

strongly suggest the influence of the endocrine glands. Furthermore, in view of our findings of definite pathologic changes in structures other than the muscles, especially the skeletal, we may reasonably conclude that the muscular anomalies are but part of a more general pathologic participation. In all of our cases we found symptoms of disturbance in the physiologic chemistry of the organism identical with those recognized in dysfunction of certain of the organs of internal secretion; further, we found clinical evidence in nearly all of our cases of changes in trophism, of hair, skin, nails, etc.; anomalous distribution of hair in some; pigment and fat deposits, local and general; and characteristic osseous changes in others. Roentgenographic studies made in each case showed, in all but one, rarefaction of the skull and long bones with underdevelopment and peculiar cavity formation; in one there are distinct acromegalic features. The metabolic changes are essentially those found in disease of undisputed endocrine origin, such as Addison's disease, hypopituitarism, myxedema, and after experimental removal of the thyroid or adrenal glands in animals.

The metabolic experimental findings of Janney, Isaacson, and myself (reported in the Archives of Internal Medicine, February, 1918) in 9 of the cases here presented to you are briefly as follows: A marked decrease in the preformed creatinin, abnormal presence of creatin in the urine, low values of creatinin in the blood, a normal amount of creatin in the blood, hypoglycemia, and delayed glucose utilization. What do these findings suggest? Hypoglycemia, that is, abnormally small amounts of sugar in the blood, is observed in conditions known to be due to dysfunction of certain of the endocrine glands, *e. g.*, in myxedema and cretinism. In the latter, creatin has been found in the urine. Creatin, as you know, is intimately associated with muscle structure and function, and it has been determined that there is a relationship between endocrine function and the excretion of creatin and creatinin. Creatin is not normally present in the urine. The amount of creatinin in urine may be regarded as a measure of muscular efficiency. In exophthalmic goiter, myotonia congenita, myasthenia gravis, and in muscular dystrophy

the excretion of creatinin is markedly diminished. The suprarenal glands doubtless play a rôle in the metabolism of muscle as shown by their influence on creatin excretion. In rabbits a lesion of the suprarenals causes a more or less marked diminution of the creatinin production. Injections of adrenalin increase the excretion of creatinin. Hypophysis extract, subcutaneously injected, augments the daily creatinin output, especially when that of the posterior lobe is injected. Thyroid extract has no effect on the creatin and creatinin output, as determined by animal experimentation. Removal of the ovaries does not alter the creatinin production, but the animal no longer reacts with increased creatinin excretion after subcutaneous injection of adrenalin or hypophysis extract. Thus we see the direct bearing upon muscle metabolism of the endocrine secretions.

In this hospital Janney has found a delay in the utilization of carbohydrate, as shown by a study of the sugar curve of the blood in cases of cretinism and exophthalmic goiter. It is, indeed, not improbable that the pathogenesis of at least some of the primary myopathies lies in defects of carbohydrate metabolism. We know that the presence of creatin in the urine is a sign of destruction of muscle tissue and that creatin immediately disappears from the urine when carbohydrate is ingested. It would appear that disturbed carbohydrate metabolism is the basis of the metabolic changes found in muscular dystrophy, and also that in this disease a degenerative process, as a result of disturbed carbohydrate metabolism, is undergone by the muscles not receiving their normal supply of pabulum, and, as a result, creatin appears in the urine. The process appears to be primarily one of endocrine dysfunction with secondary disturbances of metabolism.

Let us consider further this influence of some of the endocrine organs upon muscle function. The action of the suprarenal secretion on muscle activity is striking and strongly suggests the influence of that endocrine gland in the muscle diseases. The most important signs of suprarenal insufficiency are muscular asthenia and muscle hypotonia; other symptoms, such as melanodermia, gastro-intestinal derangements, and celiac pain being less usual.

Opotherapy, especially administration of suprarenal gland, fre-

quently very favorably influences the muscle fatigability and the asthenia. Furthermore, there seems to be a direct relationship between the established symptoms of suprarenal insufficiency and myasthenia gravis. The latter is characterized by paroxysmal fatigability, next asthenia, and finally permanent paresis of the affected muscles. The muscles show the characteristic myasthenic reactions. In addition, hypotension of the vascular system, shown by lowered blood-pressure, is present. The manifestations of suprarenal insufficiency differ from those seen in myasthenia by the involvement of bulbar centers which are affected in the latter, and by generalization of the muscular weakness in deficient adrenal secretion. Not infrequently, however, alteration of the suprarenals, found in myasthenia, with pigmentations and hypotension, is favorably influenced by opotherapy. In one of my cases in private practice the symptoms of myasthenia gravis were for a time markedly influenced by opotherapy (thymus), especially large doses. I recall just now the favorable reports throughout the literature of the several endocrine hormones in muscle affections. Hypophysis therapy is reported to have yielded favorable results in affections of the myocardium, both in the course of certain acute intoxications and infections, but especially in some chronic conditions of myocarditis, and finally in tachycardia. P. Carnot (Paris, 1911) speaks of such cases, and the same observer has seen improvement from thymic therapy in cases of muscular dystrophy. The literature contains innumerable references to cases of various types of muscular affections favorably influenced by endocrine therapy.

A review of the literature discloses many references and reports of cases to show that the phenomena of myasthenia gravis, with its peculiar and characteristic muscle disturbance, has etiologic relationship with perverted endocrine activity. As in other phenomena of muscle metabolic derangement, no one gland can be positively identified. Primarily, there is much to suggest thymic influence, its pathologic activity causing the entrance of products with a toxic action into the circulation. Myasthenia associated with exophthalmos and pigmentation of the skin, as seen in adrenal insufficiency, etc., repeatedly observed and re-

ported, suggests pluriglandular activity. Just how the suprarenal secretion influences muscle structure we do not know definitely. The suprarenals are credited with the property of destroying or neutralizing toxic substances which originate with contraction of the muscles. The suprarenal cortex secretes lecithin, which has a myotonic property and which contains adrenalin. The suprarenal parenchyma secretes adrenalin which has the property of raising blood-pressure and a muscular tonic action. Contact of adrenalin with striped muscle tissue destroys its efficiency, especially when the muscle is fatigued. Greater muscular efforts lead to increased production of adrenalin. The muscle requires adrenalin for its contraction. In suprarenal insufficiency the myotonic element is lacking. The relationship, therefore, between muscle tone and activity and this endocrine influence is apparent.

On the other hand, the influence of another endocrine gland, the pituitary, on unstriped muscle-fiber is known to you, and gives further substantiation of endocrine importance in determining muscle activity and perhaps muscle integrity and development. Just as skeletal growth is influenced by pituitary activity, so doubtless is muscle structure. We are all familiar with the striking stimulating effect of pituitary extract upon the muscles of the uterus, bladder, and small intestine. It is established that the contractions of the muscles under the influence of pituitary extract are prolonged in time, but are of less frequency. This peculiar prolonging of the contraction suggests the perhaps analogous prolonging of the contraction as seen in certain muscle diseases, and as demonstrated in some of our cases today, and as seen in myotonia congenita, or Thomsen's disease, and possibly tetany. In the latter thyroid or parathyroid influence can scarcely be disputed. Animal thyroid extirpation experiments, as well as partial removal in humans, has resulted in tetany.

Functional disturbances of one of the endocrine glands are apt to be associated with similar disturbances in the domain of the other glands of internal secretion, so that it is sometimes difficult to identify positively the primarily diseased organ. I would call your attention to the existence of an apparently close

anatomic and physiologic connection between many endocrine glands as shown in the clinical picture by the onset of symptoms, in disease of one endocrine gland which can be referred to functional disturbances on the part of another, or several other glands of internal secretion. The variegated interrelations between the endocrine glands are well established at the present state of our knowledge, and isolated affections of individual organs of this group are now known to occur much less frequently than was formerly believed to be the case.

The term "pluriglandular insufficiency," of French writers (Claude and Gougerot, 1907), is applied to a symptom complex based upon the universal atrophy and functional insufficiency of a series of endocrine organs. It must be kept in mind, however, that functional disturbances of an internally secreting organ, in the positive or negative sense (meaning increased or diminished function), are not necessarily followed by analogous changes in the activity of the other organs, so that, as a matter of fact, the hyperfunction of some endocrine organs is found to be associated with the hypofunction of others, and vice versa. For example, cases of polyglandular insufficiency have been described combined with hyperpituitarism, and others with hypopituitarism.

In persons with an apparently congenital inferiority of the endocrine organs symptoms pointing to a diminished function of several internal secreting glands, in a great variety of combinations, make their appearance at the time of puberty or later, under the influence of various injurious factors, such as infectious diseases, especially tuberculosis and syphilis, abuse of alcohol, etc. The most clearly outlined of these multiglandular affections is the *thyreo-testiculo-hypophyseo-suprarenal syndrome*, in which deficiency symptoms on the part of the thyroid gland (apathy, muscular weakness, loss of hair, changes of the skin and teeth) are combined with signs of diminished function of the sex glands, and with symptoms referable to disease of the hypophysis and the suprarenals. Other cases present the thyreosuprarenal, thyreohypophyseal, or hypophyseosuprarenal type.

Up to now our positive knowledge of the pathogenesis of the primary myopathies, particularly the dystrophies, is confined to

the nutritional disturbances found in the substance of muscle, and are apparently independent of changes in the central or peripheral nervous system. The nutritional changes, as we have shown, are not confined to muscle tissue, and thus indicate more general, though selective, metabolic changes. In addition to the muscle pathology we have found articular, osseous, and skin changes.

In view of the relations of the endocrine organs with the sympathetic and autonomous nervous systems, as well as their interrelations, it is not unlikely that any disturbance of one endocrine gland disturbs the equilibrium of the entire system. Certain apparent exceptions to the established rule of endocrine activity awakens the suggestion that at least some of the endocrine glands excrete two distinct and antagonistic hormones.

From the therapeutic standpoint it seems perfectly feasible to consider, first, treatment of the mother during the period of gestation with that gland which, after careful observation and study, is apparently the seat of dysfunction; for muscular dystrophy, as we have seen, is a familial defect. One male offspring, as we know, afflicted with the disease is but a herald of successive members of the family. Again, in very early life were selective endocrine therapy studiously carried out we might find the element that appears to be a factor, or perhaps *the* factor, in regulating the defective metabolism. This is but a suggestion, although, in view of what has been presented to you today, I feel justified in urging this method of therapy in a disease which is so far progressive and fatal.

Insufficiency of gonadal secretion in the male may be observed at any age. The majority of our cases showed defective development of the genitalia. In several you will have observed that the voice is rather high pitched and like that of a child. During growth the symptoms of testicular insufficiency usually are a feminine or childlike voice; non-growth of hair on the lip, chin, or pubes; the shoulders remain narrow, whereas the pelvis becomes broad; the legs are long; early obesity appears; the character fails to show, or loses energy and decision; and the epiphyseal cartilages do not ossify. After growth has been attained

the symptoms are essentially nutritional, terminating in obesity, loss of will, and muscular weakness. Increased testicular function at the time of puberty is characterized by excitement, overactivity, and irritability of the various psychic and somatic functions. Of course, we must ever associate the activity of the gonads with the other internal secreting glands.

A number of experimental investigations on the thymus gland have been carried out. Very young white mice and rabbits were injected with the blood-serum of full-grown animals of the same species, with complete or nearly complete involution of the thymus. These injections were given for about eight days, and the animals were then killed after a varying length of time. Autopsy showed a distinctly lessened volume of the thymus, with more or less advanced histologic involution and delayed ossification; and, at the same time, a slight general body growth and diminished vivacity. Very young rabbits and dogs which were treated in the same way with blood-serum of young animals with a normally functionating thymus presented a distinct increase in volume, with perfectly normal histologic behavior of the thymus; ossification and general body growth were above the normal and there was evident increased vivacity. All cases were controlled in non-injected animals in the same litter. The thymus, certainly in early life, appears to be a factor of influence upon osseous development. Two of the cases of dystrophy we had in this hospital have died. Autopsy was performed in one and the thymus was found to be in a state of subinvolution.

CLINIC OF DR. REUBEN OTTENBERG

MOUNT SINAI HOSPITAL

A SURVEY OF THE HEMORRHAGIC DISEASES WITH ESPECIAL REFERENCE TO BLOOD FINDINGS[1]

Salient Points in the Clinical Classification of Hemophilia, Multiple Hereditary Telangiectases, Purpuras, and Hemorrhagic Disease of the Newborn. Laboratory Findings in Hemorrhagic Diseases; Lesions of Blood-vessels, Coagulation Time, Physiology of Blood-clotting. Infectious and Toxic Causes of Purpura. Application of Blood Findings in Diagnosis. Three Simple Tests in Hemorrhagic Disease.

Introduction.—The tendency to bleed was formerly called a diathesis. Within relatively recent years this vague "diathesis" has gradually emerged as a number of distinct conditions, some of them primary, so far as we can see, and some secondary to other disease. The pathogenesis of a few of them has become clear, and it is now possible to identify several by relatively simple laboratory findings. It is my purpose to present today the salient points in the clinical classification and to discuss those blood findings which are of value in diagnosis.

HEMOPHILIA

As a result of the now universally accepted fact of prolonged blood-clotting and of the equally well-ascertained and peculiar form of heredity, hemophilia has now been set off as an absolutely definite disease.

It is as much of a mistake to call anyone who shows a tendency to protracted bleeding a hemophiliac as it would be to suppose that everyone who coughed was suffering from pneumonia.

[1] Clinical lecture delivered in the wards of Mount Sinai Hospital May, 1918.

Hemophilia is a specific disease. It occurs only in males. There is some dispute about this latter point, but in all likelihood the English workers on heredity, Bulloch and Fildes, are right as to the "maleness" of hemophilia. The supposed cases of hemophilia in females reported in the literature were probably cases of chronic purpura.

From the clinical point of view hemophilia shows itself not by the tendency to bleed profusely, but by the tendency to keep on bleeding. No matter how minute a subcutaneous capillary is opened by some trivial trauma, it is likely to form a hematoma. The slightest abrasion of a mucous membrane may bleed for hours or days—may bleed till the patient dies. Repeated hemorrhages occur into the joints from the slight trauma incidental to ordinary muscular exertion, and most hemophiliacs who survive sooner or later become chronic cripples from this cause.

The immediate cause of this tendency to bleed is undoubtedly the failure of the blood to clot, or at least to clot within a reasonably short time. This failure or prolongation of clotting is practically pathognomonic of hemophilia. It is true that it may occur in a few other conditions, such as delayed chloroform-poisoning, phosphorus-poisoning, and melena neonatorum. But in these diseases it is a transient property; in hemophilia, a permanent characteristic of the blood of the individual.

Hemophilia is a hereditary disease; in fact, it is the hereditary disease par excellence. Nevertheless, sporadic cases do occur. But these are always males and are always characterized by prolonged blood-clotting. It is likely that all hemophiliac families start with such sporadic cases.

The hereditary transmission of hemophilia is often wrongly described; the disease is stated to be transmitted only by females. And, in fact, this generally is so, but not always, and not necessarily. For instance, look at Riebold's chart of five generations of a bleeder family (Table I, page 291).

There is one instance in the chart where the disease, transmitted by a male, skips through two generations of females and reappears in the males of the last generation.

One is occasionally consulted by members of bleeder families

as to the advisability of marrying or having children. Riebold's succinct four rules as to the heredity will help in formulating this advice. They are:

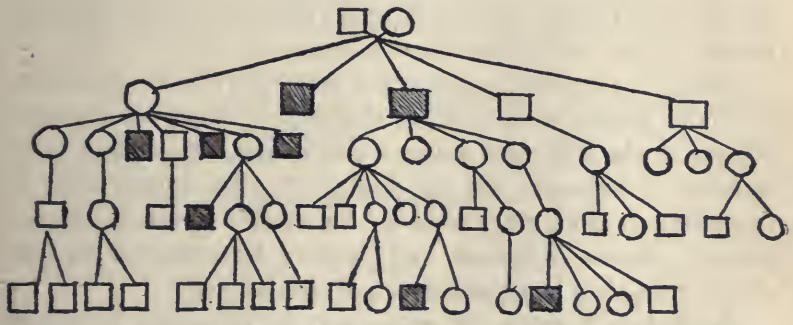
1. Hemophilia is active only in men, latent in women.

2. Latent mothers have some sons who inherit, some who do not; likewise daughters.

3. Descendants of healthy men of bleeder families are never bleeders.

4. The sons of bleeders are partly healthy, partly bleeders. The daughters partly transmit the disease, partly not.

TABLE I



Riebold's hemophiliac family: Squares indicate males; circles indicate females; shading indicates bleeders.

MULTIPLE HEREDITARY TELANGIECTASES

A group of hereditary bleeders unique in its pathogenesis and different from hemophilia in every way has been separated largely by the efforts of Osler under the name of "multiple hereditary telangiectasis." The members of these families, at about the age of puberty, develop minute clusters of dilated venules in the skin and mucous membranes. From these telangiectases exclusively they bleed, usually as the result of trauma. The hemorrhages in contradistinction to those of hemophilia are furious, but usually of short duration. There are never ecchymoses or hemorrhages into joints such as occur frequently in hemophilia, and these individuals do not bleed more than normal from cuts and bruises. The hemorrhages are never fatal except when they are from some

inaccessible mucous membrane. The blood is normal in every way. The disease affects both males and females and is transmitted by both, but it never skips generations. Healthy members of the family have exclusively healthy descendants.

PURPURA

Aside from the two sharply defined types described above the vast number of other hemorrhagic conditions are not distinct disease entities. Most of them can be, and generally are, spoken of as purpura. In order to get a clear idea of the subject it is worth while to stop for a moment to analyze our conception of purpura and classify the clinical forms as well as we can with our present rather insufficient knowledge.

Purpura, properly speaking, is a symptom and not a disease. The term applies to an acquired condition in which hemorrhages appear in the skin and mucous membranes. In a very large number of instances the appearance of such hemorrhages is secondary to some other disease. In a small group of cases no primary disease is known, and purpura here, for the present at any rate, may be regarded as a disease by itself.

Secondary Purpura.—Purpura may be secondary to a vast number of other conditions which may be classified roughly under four heads:

1. Infectious purpura.
2. Purpura due to blood disease.
3. Purpura due to toxic conditions.
4. Purpura due to nutritional disturbance.

TABLE II

CLASSIFICATION OF CAUSES OF SECONDARY PURPURA

I. *Acute Infections:*
   1. Of the newborn, including syphilis.
   2. General infections with staphylococcus or streptococcus.
   3. General infections with meningococcus or gonococcus.
   4. Bacterial endocarditis.
   5. Exanthemata: Small-pox, typhus, yellow fever, chicken-pox, measles.
   6. Diphtheria.

II. *Blood Diseases:*
1. Aplastic anemia.
2. Leukemia.
3. Pernicious anemia.

III. *Toxic Conditions:*
1. Affecting the liver chiefly:
   (*a*) Delayed chloroform-poisoning.
   (*b*) Phosphorus-poisoning.
   (*c*) Eclampsia.
   (*d*) Prolonged jaundice.
   (*e*) Peptone-poisoning (experimental).
   (*f*) Cirrhosis of the liver.
   (*g*) Acute yellow atrophy of the liver.
2. Affecting the bone-marrow chiefly:
   (*a*) Benzol-poisoning.
3. Mode of action unclassified:
   (*a*) Snake venom.
   (*b*) Many drugs:
      Potassium iodid, mercury, arsenic, copaiba, quinin, ergot, belladonna.
   (*c*) Anaphylaxis.

IV. *Nutritional Disturbances and Other Causes:*
1. Scurvy.
2. Nephritis.
3. Tuberculosis.
4. Alcoholism.
5. Old age.
6. Cancer.
7. Hodgkin's disease.
8. Mechanical purpura; cardiac disease.
9. Nervous purpura.

Primary or Idiopathic Purpura.—These cases present a good deal of difficulty in classification. Several clinical forms have been described which seem so distinct as to constitute, in all likelihood, separate diseases. There are, however, occasionally intermediate forms, so that we are not yet sure whether idiopathic purpura constitutes one disease with various clinical manifestations, or several distinct diseases which may occasionally resemble each other more or less closely.

The most generally accepted clinical classification of idiopathic purpura is seen in Table III. I will take the forms up in the order in which they occur in this table.

TABLE III

CLASSIFICATION OF FORMS OF IDIOPATHIC PURPURA

1. *Simple Purpura:*
   (*a*) Acute.
   (*b*) Chronic.
2. *The Erythema Group:*
   (*a*) Arthritic purpura (Schönlein's disease or peliosis rheumatica).
   (*b*) Visceral purpura (Henoch's purpura).
3. *Purpura Hemorrhagica* (morbus maculosus of Werlhof):
   (*a*) Acute.
   (*b*) Fulminant.
   (*c*) Chronic.
4. *Hemorrhagic Disease of the Newborn* (melena neonatorum).

1. **Simple Purpura (Purpura Simplex).**—This is a mild disease. Crops of purpuric spots, most commonly found on the lower extremities, are the only symptom the patient complains of, his health otherwise being perfect. There are no hemorrhages from mucous membranes and no arthritis. The disease often comes on in a short attack, from which recovery takes place in about two weeks. I have seen such a case with swelling of the spleen and a slight temperature rise.

There is another form, a chronic intermittent one, in which the patient is hardly ever free from a few purpuric spots, and at times exhibits a large number of them, and this in spite of otherwise perfect health. Both of these forms are more common in the young than in the aged, and in females than in males. The chronic form may persist for years. It is recognizable from the fact that aside from the typical petechiæ the patients usually notice that they bruise easily, so that at most times they can show a black-and-blue spot somewhere on the body.

2. **The Erythema Group.**—(*a*) *Arthritic Purpura* (*Peliosis Rheumatica or Schönlein's Disease*).—This is sometimes incorrectly called purpura rheumatica. In this condition the purpuric manifestations are about the same as those in purpura simplex. In fact, Pratt proposes that the group be limited to cases of simple purpura associated with arthritis, such as the case originally described by Schönlein many years ago. Other authors include cases with hemorrhages from the mucous mem-

branes, and still others, Osler for instance, describe association of both the above with urticaria or erythema. At any rate, the striking thing is a complicating arthritis which may involve several joints and which is usually accompanied by some, though not very much, fever. Edema of the hands or feet sometimes occurs. The title "purpura rheumatica" ought to be dropped, because there is almost no evidence to connect this fairly distinct form of disease with true rheumatism. One reason for this belief is the failure of therapeutic effect of the salicylates. Also endocarditis and pericarditis are very rare in arthritic purpura, whereas they are common complications of true rheumatism. Furthermore, typical acute rheumatism practically never shows any tendency to purpura.

(*b*) *Visceral Purpura* (*Henoch's Purpura*).—This constitutes a very distinct group of cases and is characterized by relatively little hemorrhage, but by many symptoms due to involvement of the internal viscera. It is usually seen in recurrent attacks in which abdominal pain and vomiting are the most striking symptoms. There may be diarrhea or constipation, and there may be diffuse or localized abdominal tenderness, so that cases have repeatedly been operated upon during acute crises for supposed appendicitis or other intra-abdominal lesions. Indeed, this is the chief importance of learning to recognize the disease. Arthritis is common and nephritis is so common as almost to be a characteristic of this disease. Osler in 1888 pointed out the importance of the visceral manifestations and the relation of the disease to urticaria, erythema multiforme, and the angioneurotic diseases. In making a diagnosis it is important to remember that the purpuric spots on the skin may be slight and may not appear at the onset. Swelling of the back of the hands and of the feet, often described as characteristic of the disease, is possibly associated with the nephritis. These cases are usually more severe than the cases of arthritic purpura, and they are especially serious on account of the nephritis which accompanies them and which often terminates by becoming chronic. Visceral purpura occurs in short, sharp attacks lasting several weeks, and recurring again and again.

There is undoubtedly a close relationship between arthritic purpura and visceral purpura. In both of them the hemorrhagic features assume a relatively subordinate rôle. In both of them arthritis and various forms of urticaria and erythema occur. They are often classed together, according to Osler's suggestion, with angioneurotic edema and exudative erythema under the title of "the erythema group" or "the angioneurotic group." In neither of them does one see the diminished number of blood-platelets so characteristic of purpura hemorrhagica, the next form to be described. In fact, neither of them shows any characteristic blood changes. It is quite possible that these two forms belong by themselves and have no relationship to true purpura (purpura hemorrhagica) at all. The group of simple purpuras may merely represent mild or undeveloped cases belonging to one or the other of the two main groups of purpura.

3. **Purpura Hemorrhagica (Morbus Maculosus of Werlhof).**—This is *par excellence* the form of purpura in which the hemorrhagic features predominate. The hemorrhages into the skin may be petechial, as in purpura simplex, or may be fairly extensive. Hemorrhages from the mucous membranes are the rule; epistaxis is the most frequent manifestation, and next to this in point of frequency comes menorrhagia; but hemorrhages may occur from the kidney, bladder, intestines, or, in fact, any of the mucous membranes. Arthritis is common. Nephritis and intestinal manifestations are evidenced at times, indicating a possible relationship of this form of purpura with that of Henoch. On the other hand, urticaria and erythema, which are found both in Henoch's purpura and in arthritic purpura, are very rare in purpura hemorrhagica. The disease may be acute or chronic.

The acute form is relatively infrequent. Ordinarily it is a serious disease lasting some weeks, but usually ending in complete recovery. The loss of blood is often large and may be alarming or even fatal. Superficially the hemorrhages bear considerable resemblance in character to those of hemophilia; the bleeding is slow but persistent and may occur from any minute lesion. Petechiæ as well as ecchymoses occur in both conditions. The

arthritis which occurs in a considerable proportion (about half) of the cases of purpura hemorrhagica is not always easy to distinguish from the joint hemorrhages of hemophilia. Nephritis and edema when they occur in purpura may aid diagnosis, but they only occur in a relative minority of the cases. In fact, there are so many points of resemblance that Frank applies the name pseudohemophilia to purpura hemorrhagica. And there is no doubt that before the introduction of the modern diagnostic criteria (coagulation time, bleeding time, and platelet count, which will be discussed a little later) many cases of purpura were mistaken for sporadic hemophilia and were so described.

There is a fulminant form which is one of the most terrible diseases known to medicine. The patient bleeds almost without cessation, the blood oozing from the various mucous membranes until death ensues, usually in a week or two. Several cases in the literature, and two in my own experience in which there was marked diminution or complete absence of polynuclear cells from the blood, suggest that this is a toxic condition in which the bone-marrow is directly attacked by some specific poison. This is plausible, particularly in view of Selling's work on benzol-poisoning, in which very similar clinical findings and pathologic pictures occur.

The chronic form of purpura hemorrhagica is more common than the acute. In fact, many authors, such as E. Frank and A. Miodet, believe that purpura hemorrhagica is always chronic, and that the cases which have been described as acute, with complete recovery, are simply those of individuals who have drifted out of sight before the recurrence, which these authors state may be delayed many months or even as much as nine or ten years.

4. **Hemorrhagic Disease of the Newborn.**—This is an important condition, and I discuss it along with purpura because it does not fit anywhere else, rather than because it is closely related to purpura. There is some doubt whether idiopathic hemorrhagic disease of the newborn deserves to be described as a separate clinical entity at all.

Among the newborn infants who bleed, one has to separate,

in the first place, those cases of true hereditary hemophilia. A large proportion of the deaths in hemophilia among the newborn are due to hemorrhage from the umbilicus or from circumcision. There are newborn infants which bleed from simple ulcers of the stomach or duodenum. Furthermore, one has to rule out cases of Winkel's disease, an acute epidemic infectious disease occurring chiefly in institutions and characterized by hemoglobinuria with icterus and cyanosis. A large number, perhaps the majority, of cases of severe purpura in the newborn are secondary to pyogenic infections or to syphilis. I have isolated staphylococci from the blood or found spirochetes in the liver of cases of this kind. Finally, eclampsia in the mother affects the infant in about half the cases and, besides liver degeneration, produces multiple thromboses and hemorrhages in various viscera.

Nevertheless, there are many cases of hemorrhage in the newborn for which no definite etiology can be assigned, and which for the time at least have to be classed as idiopathic. Those cases which show much fatty degeneration of the liver and other viscera at postmortem are often spoken of as Buhl's disease, an appellation which probably should be dropped, as the condition is not a distinct entity. Clinically, the cases resemble the very acute cases of purpura hemorrhagica. Bleeding from the stomach or intestines is most common, but the nose and other mucous membranes often bleed and purpuric spots and large subcutaneous hemorrhages occur, particularly about the head. On account of the predominance of gastro-intestinal bleeding the disease is often simply spoken of as melena neonatorum; but the gastro-intestinal hemorrhages are only an evidence of a general tendency to bleed. The mortality is high and the course is always short. The child invariably dies or gets completely well within one or, at most, two weeks.

The reports in the literature on the blood findings are contradictory. The few cases that I have had occasion to see have shown prolonged coagulation time. Icterus is usually present, and there are many reasons, which I have not time to go into here, for believing that the condition is really due to impairment of the liver functions.

LABORATORY FINDINGS IN HEMORRHAGIC DISEASES

When one considers the wide variety of causes which may lead to secondary or symptomatic purpura (Table II), one sees that there is very little clue as to the etiology from a consideration of these causes. Infections, intoxications, disturbances of metabolism, and changes in the composition of the blood all play a rôle. Indeed, from the great variety of these causes one would conclude that purpura is a symptom called forth by so many different things that one could hardly expect for it a uniform pathogenesis. And such is, in all likelihood, the case. If the pathogenesis of secondary purpura, for which many causes are known, is obscure, one might expect this to be still more true of primary or idiopathic purpura for which no cause is known. And, indeed, this is so. There has been exceedingly little etiologic research on the primary purpuras, and we have little more than the surmise that some forms are infectious and others, such as the erythema group, toxic.

Infectious and Toxic Theories.—Bacteriologic studies of all the different forms of purpura, other than those clearly secondary, have either been completely negative or have been so scattered and divergent in their results as to leave no doubt that the infectious agent, if such exists, must be one which eludes our present bacteriologic methods.

On the other hand, analogy with much experimental work in which many or most of the manifestations of purpura were produced by poisoning of various sorts, such as benzol, chloroform, diphtheria toxin, and certain kinds of sera, points to a toxic cause for the symptoms of purpura. If the causes are toxic, then, of course, the solution of the problem is simply moved one step further away and the sources of the toxic substances are to be sought.

The Blood-vessels.—Of the various ideas as to pathogenesis, the one which can be dealt with most briefly is the theory that the hemorrhages are due to degenerative lesions of the blood-vessels. The attempt to actually demonstrate such lesions has, for the most part, been a failure; and the idea that toxic or infectious lesions of the capillaries are directly responsible for

the hemorrhages is generally based on analogy. Thus Gay and Southard were able to show that a form of fatty degeneration of the epithelium lining the capillaries may occur with astonishing rapidity in anaphylaxis; and it is well known that purpuric manifestations not infrequently occur in anaphylaxis when death does not supervene too quickly. Flexner likewise was able to show that snake venom, a substance which also produces symptoms of purpura, contains a poison, hemorrhagin, toxic to endothelial cells.

Certain facts in the clinical history of purpura also speak somewhat in favor of the vessel walls being weakened. Thus petechiæ and ecchymoses have a tendency to occur in dependent parts of the body or to be brought on by mechanical causes, such as rubbing, or stasis caused by a tight bandage, or coughing, or straining at stool. All of these point to possible, if not probable, weakness of blood-vessel walls.

Alfred F. Hess has recently taken advantage of this fact and has introduced a test for the resistance of the capillary walls. This test, which is known as the tourniquet test, was meant to be applied particularly in scurvy, but can be applied to other purpuric conditions as well. He found that whereas no petechiæ appeared in the skin of normal infants if a blood-pressure cuff was put around the arm and a pressure of 90 millimeters of mercury maintained for three minutes, the capillaries of infants suffering from scurvy gave way under this pressure and minute petechiæ were found on the arm. In adults a somewhat higher pressure has to be used, as the blood-pressure of adults is somewhat higher.

Coagulation.—Most of the work on purpura of recent years has been on the subject of the blood rather than of the blood-vessels. Intensive study has been done on the physiology of blood-clotting. This was stimulated particularly by the discovery that in certain forms of hemorrhagic disease, notably hemophilia and the hemorrhages of the newborn, the clotting power of the blood was often greatly impaired, or even lost entirely. In spite of an enormous amount of work on the physiology of blood-clotting there is still a great deal to be learned.

Simple as the process of the formation of a clot looks, on analysis it turns out to be extraordinarily complex. Unfortunately, this complexity has led to very divergent views. In the maze of different terms and theories, each one supported by plausible experiments, it is hard to choose one's way. If we are to have any idea of the significance of the blood findings we must have some conception of the physiology of blood coagulation. There are certain broad outlines on which most of the experimenters are agreed:

1. The fibrin clot is formed out of a pre-existing dissolved protein, fibrinogen, present in the plasma of all animals. Fibrinogen is produced by the liver, and a deficiency of it is the probable immediate cause of the hemorrhagic tendency in certain diseases of the liver, such as acute yellow atrophy, cirrhosis of the liver, and yellow fever, and in certain forms of poisoning, such as phosphorus and chloroform.

2. The change of fibrinogen into fibrin is the result of the action of a substance called thrombin or fibrin ferment, which is not present in the circulating plasma, but is formed at the time of clotting. It is always found in serum freshly expressed from a blood-clot. It is probably the thrombin in fresh serum that gives it its therapeutic value in checking hemorrhage. Thrombin deteriorates on standing. That is why serum used in treatment of hemorrhagic conditions should be fresh.

3. Thrombin is not present as such in the blood, but is formed from an antecedent substance known as prothrombin, present in the circulating plasma. The workers are not all agreed as to the properties of prothrombin. It is described in the literature under different names, such as thrombogen (Morawitz), serozyme (Bordet and Delange), etc. It is thermolabile and deteriorates readily on standing. We are not absolutely certain as to whether it exists in the circulating plasma as such, or is given up to the plasma by the platelets as the initial act of clotting. Morawitz, Bayne-Jones, and others have shown that it can be derived from blood-platelets.

4. Calcium in the ionic form is essential for the formation of clot, because without it prothrombin cannot be converted to

thrombin. It must be exactly in the proper concentration. An excess of calcium interferes with the formation of thrombin as much as does a deficiency. There are a number of different theories as to what calcium does, but it must be confessed that its exact mode of action is at present a mystery. The amount of calcium in plasma is so small that its measurement is not practical clinically. Calcium deficiency has been reported in scattered instances of hemorrhagic disease, but in most of these the evidence is not very conclusive. It does seem probable that the delayed coagulation and hemorrhagic tendency seen in obstructive jaundice are due to the blood calcium entering into some sort of combination with bile-pigments.

Calcium salts, on the advice of Sir Almroth Wright, are much used in the treatment of hemorrhagic diseases. There is much doubt at present as to their efficacy, particularly as in most cases the supposed calcium deficit, for which they are given, does not exist. In giving calcium it is important to remember that an excess actually inhibits coagulation. I believe I have seen this happen in a case of purpura.

5. Thromboplastin is an important coagulation-accelerating substance which, like prothrombin, is derived from the blood-platelets and which, unfortunately, has received a great variety of names. Alexander Smith, the first and greatest experimenter on the subject of blood coagulation, early recognized the existence of a thromboplastic substance, as he called it; and the most recent title for the substance, "thromboplastin," used by Howell and his followers, is perhaps the best one for it. Other titles based on various views of its nature and origin are, however, frequently used in the literature. Thus Morawitz's term "thrombokinase" is based on his view that the substance acts in a manner analogous to the kinases of digestive enzymes; Bordet and Delange use the name "cytozyme," since they believe that the substance is particularly derived from cellular elements in contrast to prothrombin, which they call "serozyme," because they believe it to be present in solution. Nolf uses the term "thrombozyme" for the same substance.

This substance, for which we shall use the term "thromboplastin," is undoubtedly derived from blood-platelets at the time of coagulation, and in all likelihood it cannot be derived from red blood-cells or leukocytes. A substance identical or having closely similar properties can be obtained by making extracts of many different kinds of body tissues. It has been shown by Zak, Bordet and Delange, Howell, and others that thromboplastin is a lipin, very likely a lecithin or kephalin, since it is soluble in alcohol and ether, but not in acetone. There is very great divergence of opinion as to how thromboplastin works. Morawitz, Mellanby, and many others believe that it is an essential element for coagulation and enters into the actual formation of thrombin, uniting with prothrombin for that purpose. Howell and his school believe that its action is entirely different, and that it simply neutralizes an inhibiting substance, antithrombin, present in all plasma, and in this way permits coagulation to go on. They base their view to some extent on the fact that thromboplastin accelerates clotting especially in those plasmas known to contain large amounts of antithrombin, such as the plasma of birds, peptone plasma, and hirudin plasma.

A deficiency of thromboplastin either in the blood or the tissues has been asserted for various hemorrhagic conditions, but especially and with considerable show of reason for hemophilia. There are absolutely contradictory opinions on this question, and I do not wish to enter the controversy here. But, at any rate, the enormous accelerating effect of tissue extracts and of platelet extracts on the coagulation of the blood of hemophiliacs is very easy to demonstrate.

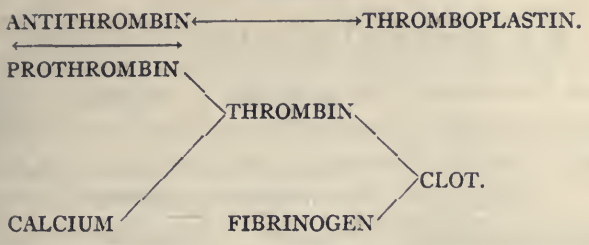
Thromboplastin has acquired important therapeutic uses. It is one of the most valuable local hemostatics we possess. It is applied in several forms either as extracts of various tissues, such as brain or lung, under the names of thromboplastin or thrombokinase, or as an extract of blood-platelets (coagulen of Kocher and Fonio), or by the direct application of fresh or living tissues (Victor Horsley). The possibility of this last application is worth remembering for emergencies when the

prepared extracts are not at hand. The intravenous use of thromboplastin chiefly in the form of platelet extract has been proposed, but must be carried out very cautiously, as the substance is very toxic when given in this way. Coagulen, however, can safely be given subcutaneously, but we do not as yet know much about its effects after absorption.

6. Not the least important of the substances which enter into the process of coagulation is antithrombin. This is undoubtedly present in normal circulating plasma. It is probably necessarily there in order to prevent excessive intravascular clotting. From the property which clotted blood has of liberating thrombin, and the power which thrombin has of forming more clot from fibrinogen, one can see that if there were not some hindering factor present, a clot once started at any point in the circulatory system would grow by accretion until it filled the entire system. As with the other substances, there is a good deal of divergence of opinion as to just what antithrombin does; whether it antagonizes the action of thrombin when once formed, or prevents the formation of thrombin from prothrombin. The latter view is that of Howell and is now most generally accepted. Howell's view of the interaction of these substances is that prothrombin is capable of forming thrombin spontaneously in the presence of calcium, but that prothrombin is constantly prevented from doing this in the circulating blood by the presence of antithrombin.

Prothrombin and antithrombin are thus always in a delicate balance, the one against the other. The only function of thromboplastin (a function by which it virtually, under normal conditions, initiates coagulation) is to combine with antithrombin, thus freeing the prothrombin so that it can form thrombin. Complicated as this theory sounds, there is good experimental evidence supporting it. The exact chemical nature of none of the substances involved is known, although thrombin has been obtained in a relatively pure condition by Howell. Whipple's diagram (Table IV) to illustrate Howell's theory will help to keep in mind how these substances interact.

TABLE IV



Antithrombin is very resistant to heat, as compared with prothrombin and fibrinogen, and on this property is based the test for its presence recently proposed for clinical use (Howell, Whipple, Hess).

Antithrombin, like fibrinogen, is believed to be produced by the liver, and the amount in the blood is increased automatically as a reaction to the presence of various substances which injure the liver or accelerate blood coagulation, such as peptone, serum, and the products of cell disintegration. A pathologic increase of antithrombin has been claimed for many hemorrhagic conditions. Whipple seems to have proved it in purpuras secondary to carcinoma of the liver, miliary tuberculosis, aplastic anemia, and leukemia. He points out that in cases of hemorrhage known to be due to antithrombin increase, serum treatment may do more harm than good, as it is known to reactively lead to the increase of antithrombin in the body. In these cases especially blood transfusion is indicated.

APPLICATION OF BLOOD FINDINGS IN DIAGNOSIS

The intensive study of these various factors of blood coagulation is ultimately bound to be of the greatest importance, and to throw much light on the causes and treatment of the hemorrhagic diseases. Their detailed study, however, has little more than begun. At present in practical diagnosis certain simple tests are of much greater importance, and give much more definite results. I will discuss three of these in detail. With the aid of these three tests alone it is possible to classify a considerable proportion of the hemorrhagic diseases (Table V).

TABLE V

BLOOD DIAGNOSIS OF FORMS OF HEMORRHAGIC DISEASE

	Blood coagulation.	Bleeding time.	Blood-platelets.
Hemophilia	Enormously prolonged.	Normal or prolonged.	Normal.
Hemorrhage of the newborn	Greatly prolonged.	Prolonged.	
Purpura hemorrhagica	Normal.	Greatly prolonged.	Greatly decreased.
Purpura secondary to—			
1. Jaundice	Prolonged.		
2. Chloroform or phosphorus	Prolonged.	Prolonged.	
3. Scurvy	Normal.	Normal.	Normal.
Purpura simplex, Arthritic purpura, Visceral purpura	Normal.	Normal.	Normal.

1. **The Coagulation Time of the Blood.**—This is perhaps the most important of all tests in hemorrhagic disease. Innumerable methods have been proposed for determining the coagulation time. The more recent studies on the coagulative properties of tissue fluids have shown that most of the coagulation time methods in the text-books and the literature are valueless. We now know that the only methods on which much reliance can be placed are those in which the blood is obtained directly from a vein through a hollow needle. The coagulation time is greatly affected by the amount of blood withdrawn. Large amounts always take a longer time to clot than small ones because clotting is initiated by some change that occurs at the surface of contact of the blood with a foreign body.

For practical purposes the simplest and most reliable method of determining blood coagulation time, therefore, is to apply a tourniquet to the arm, to insert a fairly good-sized hollow needle directly into an arm vein, and collect 2 or 3 c.c. of blood in a perfectly clean smooth test-tube. This should be placed in a

glass of water at approximately body temperature, as lower temperatures have a retarding influence on coagulation. Coagulation can be judged by tilting the test-tube from time to time. Beginning coagulation is shown by the adherence of the blood to the glass; full coagulation is shown by the clot retaining a firm form even when the tube is inverted. Normal coagulation time by this method varies from five to ten minutes.

When coagulation time is tested by obtaining drops of blood from a prick of a finger or the ear lobe, the coagulation time is always shorter than when the blood is obtained from a vein. I have seen a case of hemophilia in which the blood that came from a vein required one and a half hours to clot, and blood obtained from the finger-tip clotted in seven minutes. On the other hand, in cases of extreme prolongation of coagulation time one usually gets prolongation also in the coagulation of blood obtained from the finger-tip. In fact, in a case of hemorrhage of the newborn, I have seen blood from a needle prick of the heel fail to coagulate at all. Since, however, the coagulation time of blood so obtained generally varies simply in proportion to the amount of tissue fluid that happens to be expressed with the blood, the method should be discarded.

For the same reason, when blood is obtained from a vein through a hollow needle, it is important that the needle go directly into the vein. If the needle fails to strike the vein at once, it is better to withdraw it and try again with a fresh needle.

Prolonged coagulation time is characteristic, above all, of true hemophilia, either hereditary or sporadic. It occurs also in the hemorrhagic disease of the newborn, and in some forms of secondary purpura, particularly in those in which the liver parenchyma is greatly damaged, as in chloroform- and phosphorus-poisoning. On the other hand, the coagulation time of the blood is normal or only very slightly prolonged in all forms of idiopathic purpura and in most forms of secondary purpura.

The cause of delayed coagulation undoubtedly differs in different cases. In hemophilia the concensus of more recent opinions is that there is a deficiency in amount or in quality

of prothrombin; but there is a considerable school of important workers, such as Morawitz, Sahli, Fuld, and Mellanby, who believe that the deficiency is chiefly in thromboplastin, generally called by them thrombokinase. On the other hand, in hemorrhagic disease of the newborn and in chloroform-poisoning the prolonged coagulation is due to a deficiency of fibrinogen.

The one important outstanding fact to remember about the coagulation time is the ease with which hemophilia can be distinguished from purpura by determining it. Particularly in distinguishing cases of chronic purpura from hemophilia it is of real diagnostic value.

2. **Bleeding Time From Small Pricks or Cuts.**—In 1910 W. W. Duke pointed out that patients with purpura hemorrhagica continued to bleed from small needle pricks in the skin for a much longer time than normal people. This phenomenon had been observed in scattered cases by many others, but, due to Duke's painstaking observations, the simple test of bleeding time has become one of great clinical value. The size and depth of the needle cut do not affect the bleeding time very greatly, but it is important not to massage the part or to exert pressure in wiping away the drops of blood, as the forcing of much tissue fluid into the cut shortens the bleeding time considerably.

The technic of the test consists of making a prick, preferably on the lobe of the ear, because the skin there is generally of uniform thickness, and wiping away the drops of blood that exude with a piece of blotting-paper every half-minute. It is important to wipe all of the drop away completely, because if any blood is allowed to remain on the outside of the cut it may clot and shorten bleeding time. I have a preference for absorbent cotten instead of the blotting-paper because it removes the drops of blood more neatly. In normal individuals the bleeding stops in from two and a half to five minutes; where blotting-paper is used five to ten drops can be counted. In purpura hemorrhagica, both primary and secondary, and in hemorrhagic disease of the newborn the bleeding time is greatly prolonged and may last for hours. On the other hand, in hemophilia it is not, as a rule, greatly prolonged, though it is so

occasionally. In purpura simplex, arthritic purpura and visceral purpura, and in scurvy the bleeding time is normal. I will discuss the cause of prolonged bleeding time in purpura hemorrhagica under the next heading, blood-platelets.

3. **The Count of Blood-platelets.**—The great importance of the blood-platelets in coagulation is apparent from all I have said. These little bodies, so inconspicuous that for years their importance was overlooked, certainly give rise to thromboplastin and probably to prothrombin. The reason for the curious incoagulability of a bird's blood, if carefully removed through a cannula, is that it contains no platelets and only gets its thromboplastin from the tissues, in contact with which it coagulates with great rapidity.

Besides this, it has been known for years that agglutinated platelets form the great part of occlusive thrombi, and in this way play a direct rôle in stopping hemorrhage. Probably due to their sticky surface, they adhere to the newly laid down fibrin to a much greater extent than do leukocytes or red blood-cells. This is why the cross-section of a thrombus looks so different from the cross-section of a blood-clot. Besides this, it has been asserted that platelets are responsible for the contraction of blood-clot and the exudation of serum from it. And it is widely asserted that failure of the blood-clot to retract is characteristic of purpura. I have been unable to confirm this observation. The failure of retraction seems to be an accidental occurrence; I have repeatedly seen it in normal blood. Furthermore, retraction is a characteristic of all clotted colloids (gels). Besides this, it is hard to see how clot retraction could play an important rôle in the stoppage of hemorrhage; one would expect rather the reverse.

The remarkable reduction in the number of platelets in purpura hemorrhagica was discovered by Denys, a Belgian, in 1887, only five years after the discovery of the platelets themselves by Bizzozero in 1882. Deny's finding was confirmed by Hayem in 1895. But until recent years it has not received the attention in diagnosis that it deserves. This has been due chiefly to the somewhat difficult methods in vogue for counting the blood-

platelets. The great value of the platelet count in differentiating the cases of hemorrhagic disease has more recently been confirmed and accentuated by W. W. Duke, and subsequently by many others. He pointed out that the common feature in a considerable variety of diseases in which purpura hemorrhagica occurs as a complication is the reduction of the number of platelets in the blood. He found that this was the pathologic feature that united the cases of secondary purpura hemorrhagica with the idiopathic cases. He says: "Purpura hemorrhagica of the type described would seem, therefore, a symptom, not a disease. It is caused apparently by any agent which reduces the platelet count to a sufficient degree." In his cases, which included not only cases of idiopathic purpura but also of purpura secondary to other diseases, the number of platelets per cubic millimeter did not exceed 10,000. Furthermore, various other writers, such as Selling, with the use of benzol as a poison, Le Sourd and Pagniez, and Watabiki, by the use of sera which agglutinated or dissolved platelets, were able to produce purpura experimentally and to demonstrate the reduction in the number of platelets.

In practical work, therefore, the platelet count is a thing of real value and importance. It can be done with sufficient accuracy by a simplified method, which was described in a publication by N. Rosenthal and myself, by which one is enabled to count the red blood-cells at the same time. The method consists of the use of 3 per cent. sodium citrate as a diluting fluid. The blood is diluted in the red cell counting pipet of the hemocytometer exactly as though red cells alone were going to be counted. The blood must be allowed to stand in the counting chamber for ten minutes at least in order that the blood-platelets, which are of relatively low specific gravity, may have time to settle down to the surface of the ruled squares. They are then counted in the same manner as red blood-cells, except that on account of their relative scarcity about ten times as many squares ought to be counted. With a little practice there is no difficulty in identifying the platelets. A high-power dry lens should be used. There are several other methods almost equally easy which give satisfactory results, and the performance of a platelet count need

not add more than ten minutes to the time taken for the performance of a routine blood count. The normal number of platelets varies from 200,000 to 400,000 per cubic millimeter. Reductions below 50,000 are practically always accompanied by purpura.

The connection between deficient blood-platelets and purpura is not entirely easy to make out. If, as the experimental work seems to show, the blood-platelets are the source of most of the essential substances which go to form thrombin, it is hard to understand why in purpura the blood removed from the vessels clots in normal time in spite of deficient blood-platelets. Hess has recently suggested that the substance of the blood-platelets is simply dissolved in the blood-plasma, the platelets, as such, not being present. Even this does not completely answer the question, because if the dissolved constituents of the platelets are present, it is hard to see why they do not show their characteristic effects in checking bleeding.

Recent work by a number of observers in an entirely different field, notably by Janeway, Richardson and Park, has probably solved this riddle. In seeking for an explanation for the well-known vasoconstricting action of the blood-serum, formerly erroneously attributed to adrenalin in the blood, these workers discovered that the vasoconstricting substance is derived exclusively from the blood-platelets; it is not present in plasma free of blood-platelets. This seems to offer at once a very neat explanation of the otherwise contradictory fact that in purpura bleeding from small cuts continues for an enormously prolonged time in spite of the fact that the blood clots normally. The constriction of the opened capillaries and small vessels by the action of the vasoconstricting substance of platelets plays a great rôle in the normal stoppage of capillary bleeding. It is easy to see that the absence of this vasoconstricting substance may cause almost indefinite prolongation of hemorrhage from cut vessels.

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CLINICAL RESEARCH IN UNITED STATES ARMY BASE HOSPITAL

By Major-General William C. Gorgas
Surgeon-General, U. S. Army

September 30, 1918.

Clinical investigation in our Army Hospitals under war conditions is worthy of encouragement whenever and wherever it does not interfere with specific military duties and the care of the sick and wounded. Fortunately, it nearly always happens that the man who has the knowledge and the ability necessary to pursue scientific work is just the man who will not permit its allurements and rewards to stand in the way of his plain duty in hospitals. The Medical Department of the United States Army has always been friendly to scientific investigation from the days of William Beaumont down, but in the military scheme of things it neither should nor would be permissible to encourage even work of this kind if at the expense of the great obligations which press on us from every side, and which must, in the nature of things, have the foremost place. In times of stress, for example, during the outbreak of an epidemic disease in camp or when a Base Hospital is overcrowded with wounded soldiers awaiting bed-space and treatment, conditions are such that no self-respecting medical officer would neglect the first requirements of his calling for any consideration whatever. But there are sometimes long, humdrum, even tedious stretches in Base Hospital life, when everything is running smoothly, when the wards are half-empty, and nothing in particular happens. That is the time when the ward officer who is fitted for the task may, and sometimes does, employ

his time profitably in running over his medical or surgical cases, with a view to utilizing them for some scientific purpose. As to the ideal of excellence which may be compassed in such clinical work, that has been set for us in the stirring address which Sir William Osler delivered to the graduates of the Army Medical School in 1894:

"The clientèle in which you work has, however, more stability, a less extended range of variation than that with which we deal in civil life. In a body of carefully selected active young men you have a material for study in which the oscillations are less striking, and in which the results of the experiments, *i. e.*, the diseases, have a greater uniformity than in infancy and old age, in the enfeebled and debauched. This adds *a value to the studies of army medical officers* so trustworthy and thorough that they serve us as a standard of comparison, as a sort of abscissa or base-line. Thus you have demonstrated to us, and to the community at large, the possibilities of stamping out smallpox by systematic revaccination; in civil practice we strive to reach the low rate of mortality of army hospitals in the treatment of typhoid fever and of pneumonia. Many of the most important facts relating to etiology and symptomatology have come from camp or barrack. I often think that army surgeons scarcely appreciate that in their work they may follow the natural history of a disease under the most favorable circumstances; the experiments are more ideal, the conditions less disturbing than those which prevail either in family practice or in the routine of the general hospital. Many of the common disorders can be traced from inception to close as can be done in no other line of medical work, and the facilities for the continuous study of certain affections are unequalled. This, which is a point to be appreciated in the intrinsic education of which I spoke, gives you a decided advantage over your less favored brethren.

"Your extraordinary range of observation, from the Florida Keys to Montana, from Maine to Southern California, affords unequalled facilities for the study of many of the vexed problems in medicine—facilities, indeed, which in the diversity or

morbid conditions to be studied are equalled in no position in civil life."

This volume is a new departure in the matter of publications by Army Medical Officers of the Army in war time. Since the declaration of war, and particularly since our Base Hospitals have been going concerns, our funds for printing have been small and we have had to rely upon the medical journals of the country as repositories for our publications. The "Military Surgeon" is entirely devoted to this end, and some of our leading medical weeklies and monthlies have generously set apart a special section of their contents for contributions on "Military Medicine and Surgery." The present volume is the first attempt to publish a large collection of clinical material from our Base Hospitals in block and in bulk. Aside from its face value to the physician, a collection of this kind possesses an additional prospective value to our medical establishment, in connection with the projected Medical History of our participation in the present war.

In England the idea of "interim publications," that is, preliminary communications on some of the leading themes of such a history, has been freely encouraged from the very beginning of the war. In accordance with the proviso of Section 16 of the National Insurance Act of 1911 (Great Britain), a Medical Research Fund, consisting of "an annual sum calculated at the rate of one penny in respect of each insured person in the United Kingdom, payable out of monye sprovided by Parliament," was set aside for purposes of scientific investigation in medicine. Under the statutory rules formulated in 1914 this Medical Research Committee consists of nine persons appointed for three years to prepare schemes for research, with estimates of expenditure, which have to be approved by the National Health Insurance Joint Committee after conference with an Advisory Council for Research, also appointed for three years. In 1913–14 the sum available for this purpose amounted to about £55,000 ($275,000). This fund, which under ordinary circumstances would have increased slightly from year to year, in proportion to the natural growth of the population and the

increase in number of insured persons, was found to diminish, after the outbreak of the war, owing to the enlistment of insured persons in the British Army. On March 25, 1914, the Committee contracted to purchase the Mount Vernon Hospital building at Hampstead, with its freehold site and grounds, as a Central Research Institute. At the outbreak of the war this building was placed at the disposal of the War Office, and became the Hampstead Military Hospital, the laboratory work in applied physiology, bacteriology, biochemistry, etc., being carried forward in other hospitals and institutions. Work in connection with the war was begun at once both at the Hampstead Hospital and in the other scientific departments. It included investigations on army medical statistics and records, pathology, wound treatment, internal medicine and neurology, industrial fatigue, and the health of munition workers; in fact, all the phases of military medicine which had become of outstanding importance from the time of the retreat of Mons and the battle of the Marne. These investigations, variously published in the British Medical Journal, Lancet, Journal of the Royal Army Medical Corps, etc., have latterly been summarized, for the most part, in the valuable series of special Reports of the Medical Research Committee. This indicates the probable line which we shall have to take if our participation in the present war should, as with our Allies, cover several years: First, continuous and liberal publication of our scientific material in the medical periodicals; second, digests of large amounts of material (including laboratory work) in the form of serial monographs; third; final assimilation of all this material in the definitive volumes of the history itself. In this way only can large amounts of our scientific material be handled as we go on, and before we are swamped with the whole mass of it. Here we are only profiting by the experience of Great Britain, as set forth in the following paragraph of Sir Walter Morley Fletcher, Secretary of the English Medical Research Committee:

"I think these principles we suggested at the beginning were sound, and I think we can claim that they have been wholly justified by experience. An immense volume of work in all

these subjects has been done, and much of it has been published already. These interim publications have brought immediate aid by information to the present workers. They do not in the least (as some were inclined to fear) detract by anticipation from the value of the future Medical History, while, as I think, they have provided a chief condition for its success. These interim publications cannot damage the Medical History, for the value of the History will consist in its combination of all the fragments in a regular architecture."

From the experience of our British allies, which now covers a period of four years, and using the end-result of this organization as our point of departure, we shall, as the war goes on, have to deal with the problem of finding funds for serial publications of laboratory and clinical investigations of large dimensions. For the present we shall have to rely upon the patriotic spirit and friendly assistance of the editors of periodicals devoted exclusively to scientific medicine and of publishers of well-established serials of the present kind. The advantage of scientific publications in serial form over the ordinary periodical form is that they are not limited by the condition of periodicity; in other words, they need not be issued until a sufficient amount of worthy material has accumulated. The Monographs issued at indefinite intervals by the Rockefeller Institute afford a good example of this species of medical serial. Its success is conditioned in part by the fact that production and publication are not hampered by the ordinary time-limits. There are few medical serials of this kind in the United States, but we shall feel the need for them more and more. Our younger school of scientific physicians is doing good work, and their number will increase.

As to the Base Hospitals themselves, they demonstrate, among other things, the teaching value of medical war history, being "almost exact replicas of structures erected in this country during another war over half a century ago," and described in the Medical and Surgical History of the Civil War.[1] At the outbreak of the Civil War both Federal and Confederate

[1] Wood: Military Surgeon, Washington, 1918, xlii, 539–548.

forces found themselves confronted by the large problem of providing immediate shelter and treatment for thousands of sick and wounded soldiers. The military authorities on both sides were obliged to commandeer and use almost any buildings available in any particular neighborhood. First tents and dwelling houses, later hotels, churches, factories, warehouses, schools, colleges, and other municipal structures were freely employed, and barrack buildings were also reconstructed for this purpose. In Washington, D. C., the National Hotel (1861), Georgetown College, Odd Fellows Hall, and many churches were speedily converted into extempore hospitals; in Alexandria, Va., the old Hallowell House, the Bell Haven Institute, the Methodist Church, the Fairfax Theological Seminary; in Baltimore, the National Hotel; at Annapolis, the Naval Academy.[1] On the Confederate side, we find the same state of affairs. At Corinth, Mississippi, the Tishomingo Hotel and other buildings; at Gulf Port, Mississippi, a large planter's residence, with kitchen and out-houses; a church at Chattanooga; at Macon, Ga., a former school for the blind; at Kingston, Ga., a number of old stores; at Atlanta churches and stores all over the city were used as hospitals.[2] As the wounded poured in from the great battles there came the need for expansion, and thus additional structures for wards came to be grouped around the original building or buildings. This was the origin of the modern Base Hospital. In the neighborhood of large camps, near the bases of supplies and the line of communications, it became expedient to run up groups of ridge-ventilated wooden pavilions of one story each, tactically arranged in various geometric figures around a central administration building, and connected by covered passageways. The first of these was the large wooden hospital erected at Parkersburg, Va., in 1862, which was divided by wooden partitions into four wards of twenty beds each. This was followed by hospitals of similar plan and ventilation at New Kirk, Va., Gallipolis, Ohio, and Clarysville, Md. Then came

[1] Medical and Surgical History of the War, Washington (Medical History), 1888, iii, 896–966.

[2] Kate Cumming: A Journal of Hospital Life in the Confederate Army of Tennessee, Louisville, Ky., 1866.

the large communal pavilions, such as the Satterlee Hospital at West Philadelphia (3519 beds), with fourteen parallel pavilions projected from each of the corridors; the V-shaped Lincoln and Harewood Hospitals at Washington, D. C., with the wards arranged *en echelon;* the Mower Hospital at Chestnut Hill, Philadelphia (3100 beds), a rounded quandrangle of fifty pavilions, enclosing the administration building; and the semicircular Hicks Hospital, at Baltimore, Md. The larger hospitals of the Confederacy, such as the Chimborazo at Richmond, the Newsom (Chattanooga); the Bragg Hospital (Ringgold, Ga.), and the General Hospital at Okolona, Miss., followed the same trend of expansion.

Our present Base Hospitals are usually quadrangular arrangements of single-storied wooden pavilions, of the same type as those of the Civil War period, connected by covered corridors, with a compact administration building at the center of one side of the quadrangle, and isolation wards, convalescent pavilions (two stories), quarters for officers and enlisted men, and other necessary buildings, as outhouses. These hospitals were, unfortunately, the last things to be put up when the camps were organized and the cantonments built; so that the unprecedented and wholly unexpected severity of the winter of 1917–18 had its bad effects upon the infectious diseases which broke out in camp. But we have already profited by experience to the extent that we are now fully equipped and able to cope with any epidemic diseases that may attack the newer and later drafts. In medical and surgical personnel, in laboratory facilities and equipment, these hospitals are abreast of any hospitals in civil life.

The Laboratory Service of our Army Medical Department is fully adequate to deal with any scientific problems which may come up, and already includes three special laboratories for investigating the pathology of gas-poisoning and one for disorders of respiration in aviators. A number of scientific studies from these laboratories are awaiting publication. The present volume of clinical contributions is typical of much of the work which has been produced in the Medical and Surgical Sections of the various cantonment Base Hospitals in this country.

A STUDY OF THE EPIDEMICS OF PNEUMOCOCCUS AND STREPTOCOCCUS INFECTIONS, AND MEASLES, AT CAMP ZACHARY TAYLOR, KENTUCKY, AUTUMN, 1917, TO SUMMER, 1918[1]

By Major Walter W. Hamburger, M. C. (Chicago), and Major Herbert Fox, M. C. (Philadelphia)

I. INTRODUCTION

A. Statement of Problems.
B. Definition of Terms.
C. Acknowledgment to Associates.

II. EPIDEMIOLOGY

A. Chronological Development

First period: September, October, and November, 1917. Lobar pneumonia period.

Second period: November and December, 1917; January, 1918. First measles and measles pneumonitis period.

Third period: December, 1917; January and February, 1918. Streptococcus, atypical pneumonitis, and pleuritis period.

Fourth period: Second measles, measles pneumonitis, and streptococcus period. March and April, 1918; May, 1918.

Fifth period: Decline of epidemics. May, June, and July, 1918.

B. Discussion

III. BACTERIOLOGY

Pneumococcus: Types, prevalence, technic, etc.
Streptococcus: Type, prevalence, technic, etc.

IV. HYGIENE

Camp { Depot brigade, Regimental infirmaries, Barracks.

Hospital { Receiving ward, General medical and surgical wards, Hospital personnel.

V. CLINICAL PICTURE

Pneumonitis,
Pleuritis,
Measles,
Streptococcus disease.

[1] From the Medical and Laboratory Services, Base Hospital, Camp Zachary Taylor, Ky.

VI. METHODS ADOPTED TO CONTROL THE EPIDEMICS

Camp { Detention camp,
Regimental infirmaries—sick call,
Communicable diseases—cubicles and masks.

Hospital { Medical treatment,
Routine service orders,
Withdrawal of fluid,
Surgical treatment—time of election for surgical interference,
Diet,
x-Ray,
Convalescence—disposition.

VII. RECOMMENDED MEASURES FOR FUTURE CONTROL

Camp { Separation of immunes and non-immunes,
Separation of streptococcus carriers and non-carriers,
Prophylactic vaccination—pneumococcus and streptococcus,
Instruction in personal hygiene and methods of spread and prevention of communicable diseases,
Postponement of infections by control of fatigue and exposure during acclimatization.

Hospital: Segregation of carriers and non-carriers.

VIII. SUMMARY AND CONCLUSIONS

IX. LITERATURE

I. INTRODUCTION

A. **Statement of Problems.**—Many of the thirty-two cantonments distributed throughout the country were visited and revisited with epidemics of respiratory disease, notably diseases by either pneumococcus, measles, or streptococcus, during the first year of the mobilization and training of the young men of the nation for war. These various epidemics occurred and recurred in waves of increasing and decreasing morbidity and mortality; in fact, at certain times during the winter it seemed as if the entire country was in the clutch of a pandemic of disease. At the crest of these disease waves, when one was directly in the midst of the epidemic, giving his thought and time to the saving of life, a perspective of the whole could not be clearly obtained, for, at the outset, the knowledge that an epidemic was in progress and the type of that epidemic was not in the least appreciated, and not until weeks later, until information gradually sifted in from other camps, did the real truth of

the matter appear. It would, therefore, seem profitable to analyze and evaluate the experience and data of the past winter, at least so far as camp and hospital epidemiologic conditions are concerned, in order that the lessons learned thereby may be applied to the solving of similar problems, which may reasonably be expected to recur this winter.

In retrospect, the problem of last winter's epidemics may be said to be composed of three variables: pneumococcus disease, measles, and streptococcus disease, and the solution of this problem would seem to lie in an analysis of their several mutual relations and interrelations. For example, it is of importance to appreciate the etiologic and pathogenetic relationship of pneumococcus and streptococcus; of measles and streptococcus; of measles and pneumococcus, in order that adequate epidemiologic measures may be instituted, intelligent prophylactic steps taken, and morbidity and mortality cut down. It shall be the purpose, therefore, of this study to analyze the development and history of these epidemics, and to define as far as possible the importance and relative value of the several components.

B. **Definition of Terms.**—*Epidemic.*—As will be shown later, these epidemics consisted of varying waves of increased and decreased disease incidence. As used in this study, the eleven months period, from September 1, 1917, to August 1, 1918, is considered as the entire epidemic; the waves of increase and decrease are spoken of as periods of the whole.

Pleuritis (*Empyema*).—This usually connotes an acute purulent pleuritis, and is so used in this study. However, it has become increasingly clear that so-called empyema is simply the end-stage of an acute inflammation of the pleura, which inflammation starts as acute fibrinous pleuritis, and progresses through the stages of serofibrinous, seropurulent, to purulent. Some cases begin as pus, but generally all are the same. Thus the type of fluid obtained at any one time depends on the stage of the disease at which the diagnosis is established.

Pneumonitis (*Pneumonia*).—In this study it has often been difficult if not impossible to distinguish, clinically, between

lobar and lobular pneumonia. Even at the necropsy table one found great difficulty in deciding if the cases were a true lobar pneumonia or pseudolobar pneumonia, from a fused lobular process. In view of this difficulty, as well as the wide variance of even the most typical lobar pneumonia from the classical well-defined picture, we have preferred to use the term "pneumonitis" in describing an acute inflammatory disease of the lung tissue.

Measles.—The majority of the cases were frank measles, but there has doubtless crept in a number of cases of German measles, as well as a smaller group of doubtful exanthemata, which were possibly a variation of measles or German measles, a double infection, or a recurring infection of the same disease. For example, several cases beginnnig as typical German measles, with a fine diffuse, rose-colored rash, enlarged cervical lymph-nodes, and leukopenia developed on the fourth or fifth day a conjunctivitis, Koplik spots, bronchitis, and a red discrete, macular eruption; other cases of frank measles developed within a few weeks a second attack of the same; still others of typical German measles developed within a few weeks a second attack of that disease.

C. **Acknowledgments.**—It is a pleasure to express appreciation and acknowledgment to Colonel Will L. Pyles, M. C., Commanding Officer of the Hospital, whose constant sympathy and support were of greatest value. Thanks are also given for the loyal and earnest co-operation of Captain Lawrence H. Mayers, M. C., for the preparation of some of the charts; Lieut. Morris H. Kahn, M. C., for some of the curves; Lieut. Ralph C. Sullivan, M. C., for analysis of pneumonia and empyema charts; Captain Fred Sprague, M. C., for radiographic work; Captain H. J. Everett and Lieut. M. S. Bloom for medical statistics; Lieut. Baldwin Lucke for the pathologic work and special laboratory investigation on streptococcus; Sergeants Micheli, Roth, Seiler, Rogers, and Ecker for compiling statistics, stenographic and photographic work.

II. EPIDEMIOLOGY

A. **Chronologic Development of the Epidemics.**—(See Charts I, II, III, and V for course and periods.)

First Period: September, October, and November, 1917. Lobar Pneumonia Period

Number of cases	49
Mortality	4
Percentage of mortality	8.8
Type Pneumococcus:	
Number of cases Type I	4
Number of cases Type II	3
Number of cases Type III	0
Number of cases Type IV	11
Total number of cases typed	18
Deaths:	
Cases Type II	1
Cases Type IV	1
Empyema	4

These early cases of pneumonia were, in general, frank cases of lobar pneumonia, starting in abruptly with chill and temperature, rusty sputum, frank pulmonary consolidation, without complications, and benign in type. Owing to the lack of proper hospital facilities, nurses, equipment, etc., the majority of these cases were treated in the wards of the Louisville City Hospital. Type determinations could be made in but few, and Type I serum was used in only a few of the Type I cases.

Second Period: November and December, 1917, and January, 1918. First Measles and Measles Pneumonitis Period

Number of cases measles	967
Number of cases measles pneumonia	80
Mortality, measles pneumonia	18
Percentage of mortality, measles pneumonia	19.4
Empyema following measles pneumonia	18
Mortality, empyema following measles pneumonia	6
Percentage of mortality, empyema following measles pneumonia	33.33

This first measles epidemic reached its height at the end of November, approximately a month after the first three increments of drafted troops had come into camp. In general,

it may be said that this epidemic of measles was quite severe, the majority of patients being acutely ill from the start. The soldiers who later developed pneumonia and empyema were particularly prostrated upon entrance, with flushed face, dusky cyanosis, full bounding pulse, labored, grunting dyspnea, etc. With the development of pneumonitis, respirations were usually increased. The cyanosis was most striking, as one could almost tell from the color of the patient, on entrance, that he

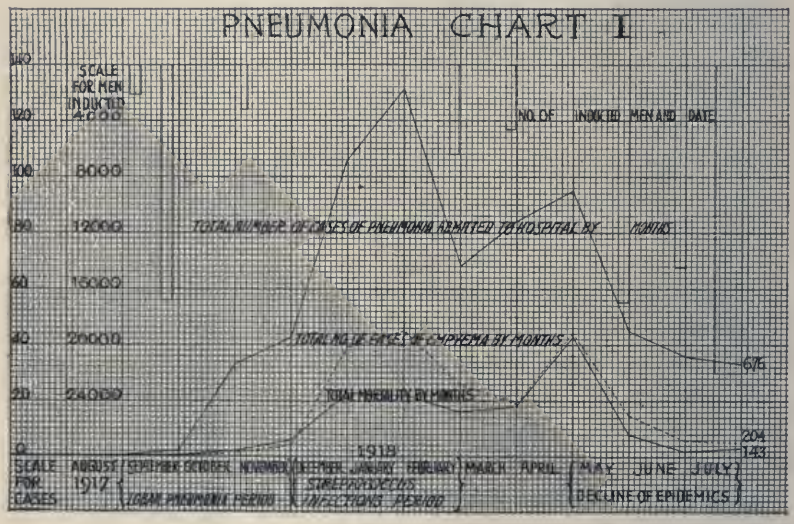


Fig. 58.—Empyema Pneumonia Chart I. Note sustained rise in mortality up to April, 1918, in spite of improved methods of treatment; with prompt fall in May, June, and July, notwithstanding repeated large increments of drafted men, and without change in methods of prophyalaxis or treatment.

was to develop or was already developing an acute pneumonia. The type of pneumonia varied, although in most instances it was grouped as a diffuse lobular or bronchopneumonia. Physical examinations of the chest revealed diffuse scattered areas of consolidation, roughened bronchovesicular breathing, large and fine moist râles. Lieut. Lucke has analyzed the post-mortem findings of these measles bronchopneumonias and has found that 9 of 16 cases group themselves into what he calls

type 1-A and 1-B. In type 1-A the lungs are largely expanded and very heavy, containing small ill-defined areas of depression and elevation. On palpation innumerable small firm areas are felt throughout all lobes, which on cut surface appear as numberless rounded, light grayish-red, definitely raised, firm areas, appearing very much like large gray miliary tubercles. This type of bronchopneumonia is probably similar to the interstitial bronchopneumonia of MacCallum. Type 1-B is simply a later stage of the preceding process, the various anatomic changes being more accentuated. The nodules palpated are larger than in the preceding type, are quite firm, and of a grayish color.

Third Period: December, 1917; January and February, 1918. Streptococcus, Atypical Pneumonitis, and Pleuritis Period

Number of cases of pneumonia	305
Total mortality of pneumonia	41
Percentage of mortality	13.4
Number of empyemas	110
Total mortality of empyemas	23
Percentage of mortality	20.9

Number of cases lobar and lobular pneumonia (without measles pneumonia)	245
Mortality	26
Percentage of mortality	10.6

Number of empyema, lobar, lobular, and primary pneumonia (without measles)	92
Mortality	17
Percentage of mortality	18.4

Of greatest interest in this series of cases was the rapid and extensive development of empyema and the presence of hemolytic streptococci in the pleural exudate. Patients entered the hospital with their chests entirely full of pus, or developed it so rapidly after coming in that it seemed as if the empyema process was the major clinical feature of the case. While in many of the cases pneumonia undoubtedly coexisted, it was most difficult to diagnose, and was undoubtedly of minor importance. The cases of so-called primary empyema were those

in which neither clinically nor at autopsy was there any convincing proof of a pneumonic process. The rapid development of the pleural pus could be demonstrated by the use of x-ray plates to occur well within twenty-four hours. In the same way that increasing cyanosis suggested beginning bronchopneumonia in the measles cases, marked prostration, severe chest pain, labored, grunting respiration usually indicated a beginning suppurative pleuritis. With the actual development of pus, resulting in a separation of the parietal and visceral surfaces of the pleura, the intensity of the chest pain diminished until the patient was in comparative comfort.

The pleural fluid in a very large percentage of these cases showed streptococci, although pneumococci were also present. The bacteriologic findings at this period were as follows:

Fluids showing hemolytic streptococci	63
Fluids showing pneumococci	26
Undetermined	15
Sterile	6

The infecting organisms of the fatal cases:

Hemolytic streptococcus	21
Pneumococcus	12
Undertermined	7
Sterile	0

The above shows conclusively the predominance of the streptococcus. Stained smears from this fluid showed countless numbers of short and long chains of streptococci.

In many of these cases the first exploratory aspiration revealed a thin, straw-yellow, serofibrinous exudate, which as the case progressed became constantly thicker and more purulent, until finally thick greenish-gray creamy pus was obtained. This change in the consistency of the pleural fluid will be referred to later in the discussion of treatment, as it was demonstrated quite early that surgical interference was of most value when delayed until this "creamy" or "purée" stage of the exudate had been reached.

The physical signs of these cases were most interesting and misleading, it being quite impossible in many instances to differentiate between a consolidation and a chest full of fluid. After considerable experience it was found that dulness to flatness on percussion and diminished tactile fremitus were the two signs upon which most reliance could be placed. However, a positive chest puncture, or positive evidence of fluid in the *x*-ray, were of greatest value. The clinical picture of these streptococcus infections will be discussed at greater length later on.

The pneumonic process seen during this period has been classed by Lucke in his report as Type II. It is similar to that already mentioned except that the lesions are not distinctly peribronchial; they are more confluent and hemorrhagic, and the accompanying bronchitis is much more intense, the mucosa being so turgid in places that the lumen is closed.

Fourth Period: Second Measles, Measles Pneumonia, and Streptococcic Period. March, April, and May, 1918

Total number of measles	414	
Cases of measles pneumonia	54	
Mortality	17	
Percentage of mortality	31	(first epidemic 19.4 per cent.)
Empyema following measles pneumonia	15	
Mortality	2	
Percentage of mortality	13	

This second measles, measles pneumonia, and streptococcus epidemic, as will be noted above, was distinctly more severe than the first epidemic. Patients came into the hospital even more acutely ill and prostrated than in the first group and died in considerably higher numbers. This may be seen in the heights of the curves on the charts, as well as the increase in mortality, from 19.4 per cent. in the first epidemic to 31.4 per cent. in the second. These boys died in spite of treatment, nothing that could be done making the slightest impression on their condition.

Further, compared with the first epidemic, twice the num-

ber developed empyema (3.6 against 1.8 per cent.), although the empyema mortality was lower (13.3 per cent. in the second, 33.3 per cent. in the first). This may be interpreted as due to improved methods of empyema treatment, as well as the fact that in these severe infections the development of pleuritis is probably a beneficent process, and indicative of good defensive reactions of the body in combating the disease, similar to the development of fever, leukocytosis, etc., in various other infections. This conception finds confirmation in the improved results from delayed surgical interference, analogous to the improved results in cases where hyperpyrexia is not too actively combated, and leukocytosis is encouraged.

In this series hemolytic streptococci played a much greater rôle than in the first measles epidemic, the general clinical and pathologic picture really being that of a generalized streptococcic sepsis with hemolytic streptococcus demonstrable in blood-stream, in secondary abscess, and at autopsy, in pericardial and peritoneal fluids. Pathologically, the lungs showed bronchopneumonia or pseudolobar pneumonia.

Fifth Period: Decline of Epidemics. May, June, and July, 1918

Total number of measles	396
Total number of measles pneumonia	9
Mortality	1
Percentage of mortality	11.11
Total number cases of pneumonia	114
Mortality	8
Percentage of mortality	7.9
Total number of empyemas	26
Mortality	4
Percentage of mortality	15.4

This fifth period is interesting, showing the marked improvement in morbidity and mortality conditions with the advent of warmer weather, although it is evident that at no time was the camp entirely free from infection. In attempting to analyze the reason or reasons for this improvement in the disease rate, there are various factors to be considered, which in the order of their importance may be listed as follows:

(A) With advent of warmer weather the men live a much greater part of the time out of doors and are not crowded in overheated and, for the most part, poorly ventilated rooms.

(B) Because of the milder weather the lowering of vitality due to chilling—exposure to wet and cold, snow, rain, and ice—is absent.

(C) As a result of being out doors more, better opportunities for drill and exercise are afforded, so that the men's own resistance is heightened, and their ability to withstand infection increased.

(D) A decrease in virulence of the infectious agents. A study in streptococcus carriers, to be referred to later, gives unmistakable evidence of the decrease in virulence of the organisms themselves. This is evident not only from a marked lowering in the relative percentage of streptococcus carriers in the camp and in the hospital but also in a marked decrease in complications and severity in disease resulting from these organisms.

B. **Discussion of the Incidence of the Cases as Shown by Plates and Curves.**—The last section (A) has traced the clinical diagnoses in their varying occurrence, while a study of the plated curves shows other and somewhat significant facts.

It is to be mentioned at the outset that the appended diagnoses are based upon the data available from our records made during the stress of work incident to the epidemic and under difficulties. We have attempted to exclude artefacts such as might occur in tabulating bacteriologic findings, but doubtless some have crept in. Data concerning case incidence, diagnoses, and complications are easier to get than bacteriologic records, and for the very early part of the season here covered, laboratory work was not as extensive as later on. With this understanding we offer the following observation upon the curves:

The curves charted by weeks indicate total cases; the outlined blocks, the total of determined cases; the blackened blocks, the deaths.

Chart II shows, in addition to the references made otherwheres, the relative importance of the pneumococcus in the early

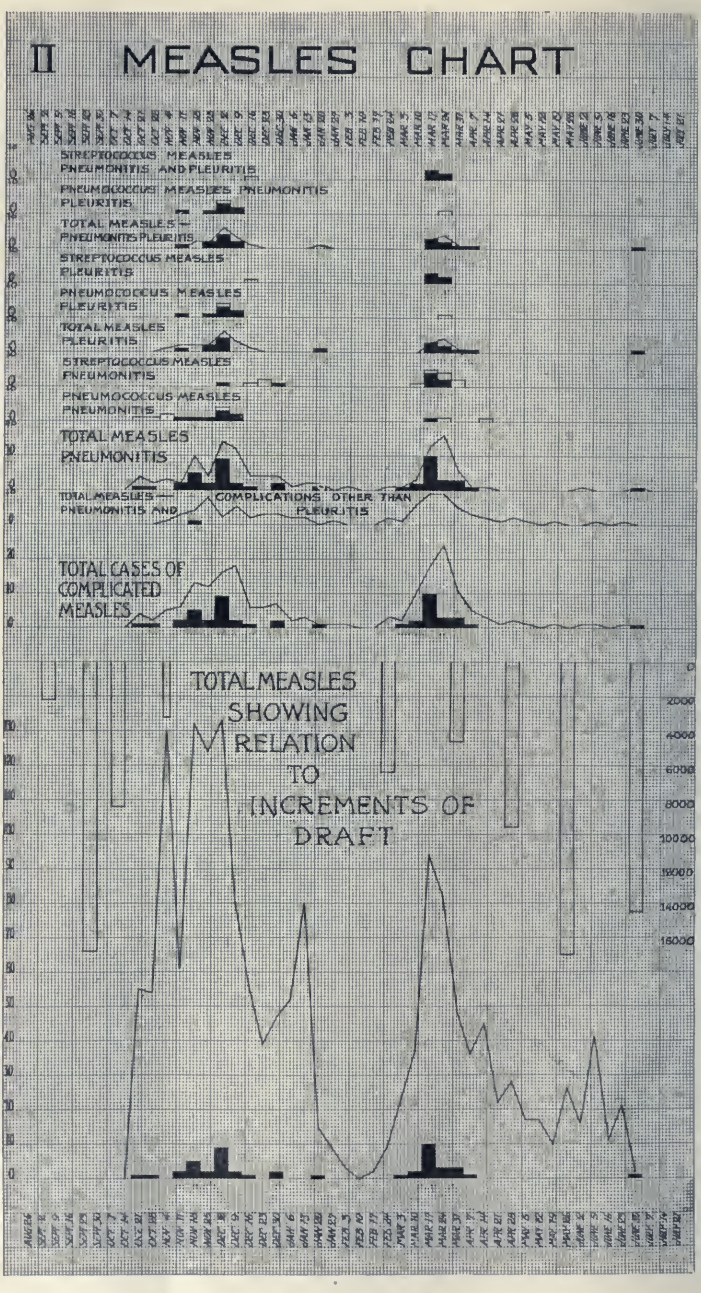


Fig. 59.—Chart II.

rise of measles and the evidence of streptococcus complications in the spring outbreak. This is again shown in Chart III, where all non-measles pneumonia and total empyemas are plated.

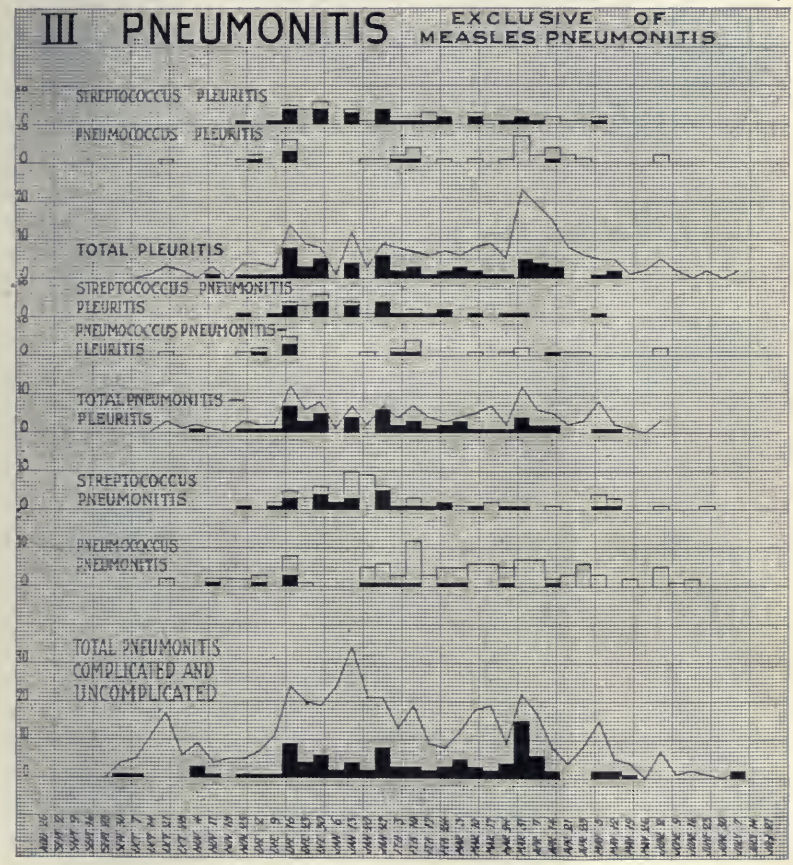


Fig. 60.—Chart III.

It seemed well to indicate other manifestations of streptococci and pneumococci, and they are portrayed on Charts IV and V.

Chart VI is merely intended to show the greater incidence of respiratory tract disease in the spring, made up chiefly of infec-

tions of the larger bronchial passages and of the acute febrile diseases without special localizations in the upper respiratory organs (grip).

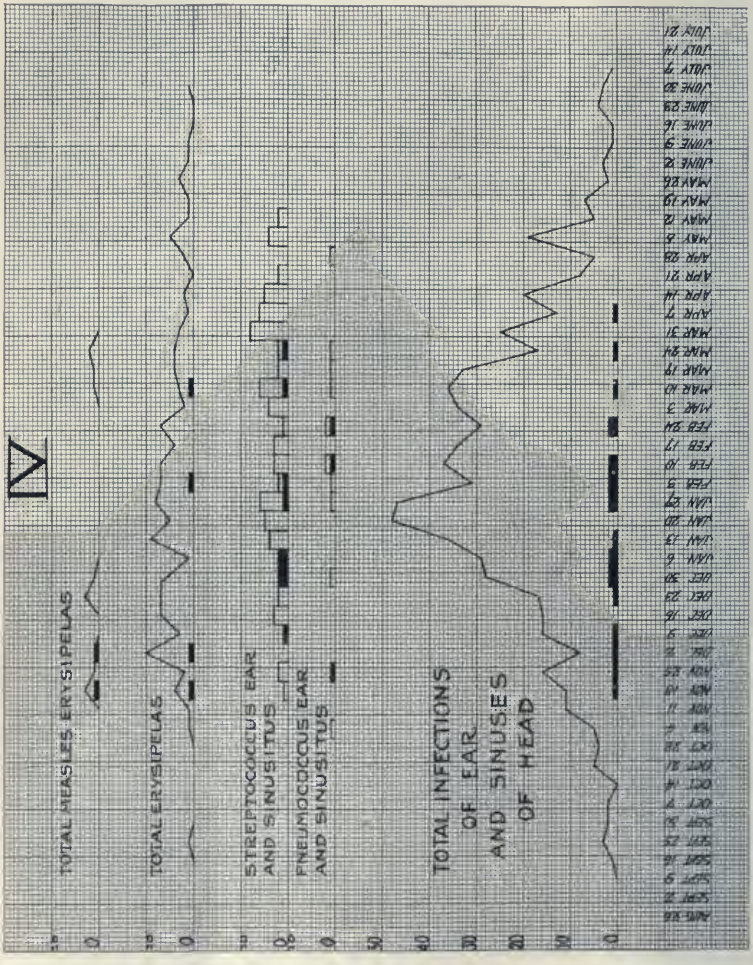

TOTAL MEASLES ERYSIPELAS
TOTAL ERYSIPELAS
STREPTOCOCCUS EAR AND SINUS ITIS
PNEUMOCOCCUS EAR AND SINUS ITIS
TOTAL INFECTIONS OF EAR AND SINUSES OF HEAD

Fig. 61.—Chart IV.

In general, a study of the charts as a whole indicates that measles cases were numerous in the fall, of lower severity, and often complicated with pneumococcus infections at that time, while later the streptococcus became the important organism.

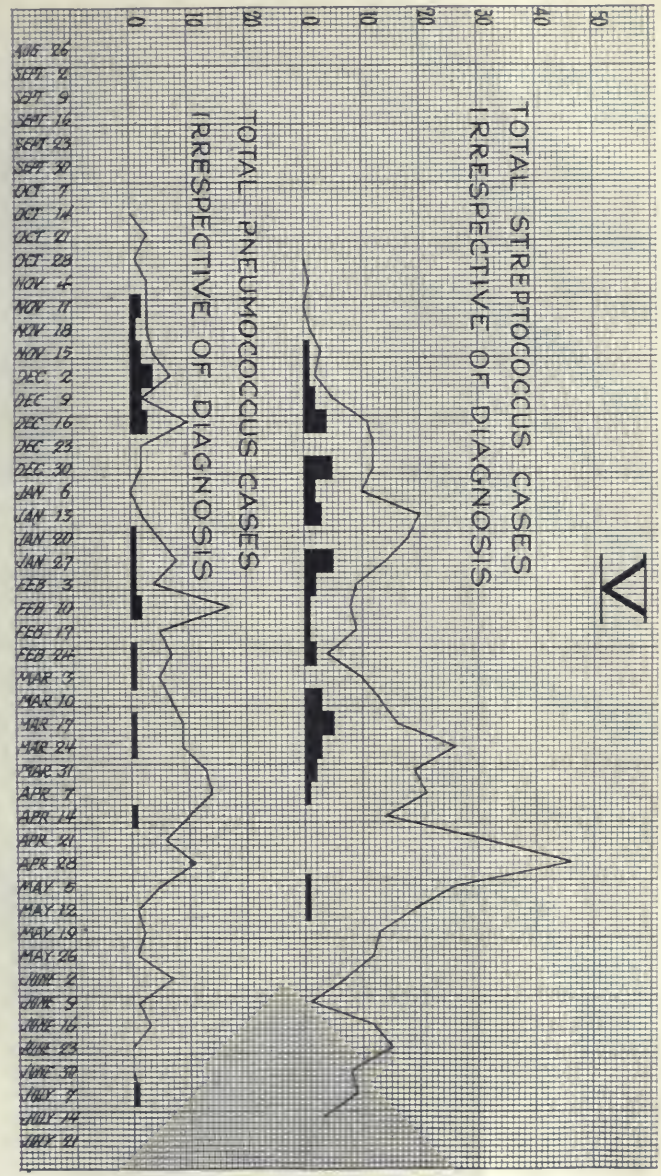
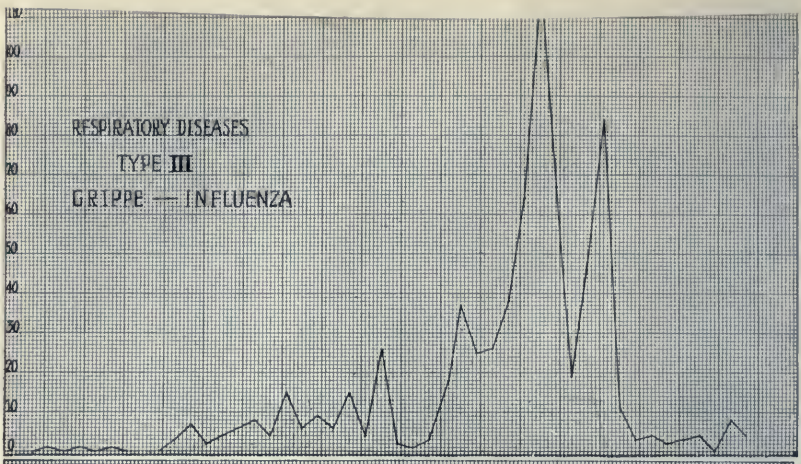
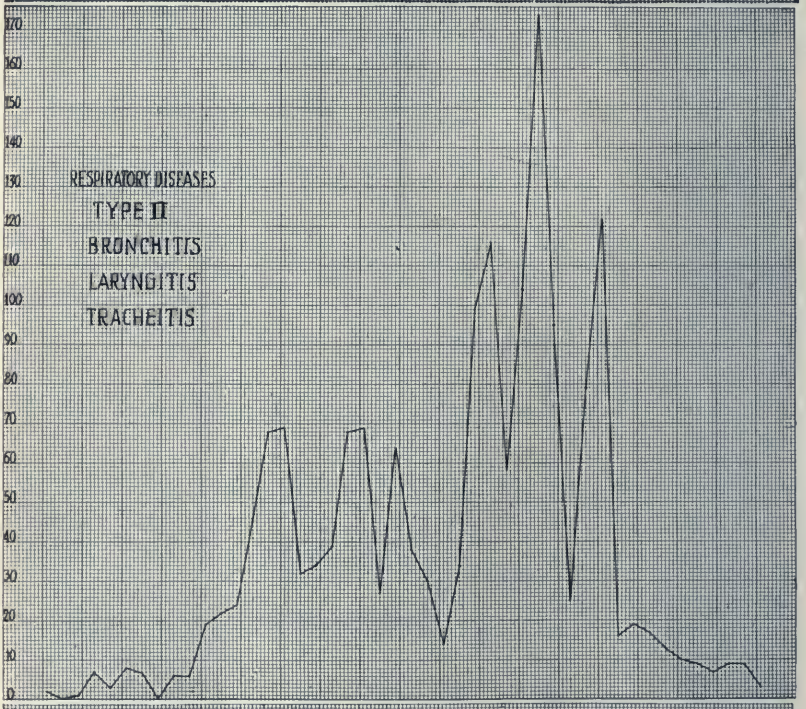
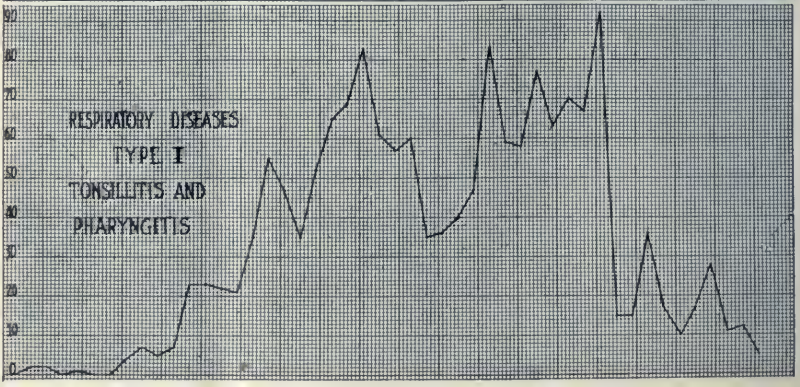


Fig. 62.—Chart V.

Indeed, all mortalities with pneumococcus are higher in the fall and those from streptococcus higher in the spring. While there


RESPIRATORY DISEASES
TYPE III
GRIPPE — INFLUENZA


RESPIRATORY DISEASES
TYPE II
BRONCHITIS
LARYNGITIS
TRACHEITIS


RESPIRATORY DISEASES
TYPE I
TONSILLITIS AND
PHARYNGITIS

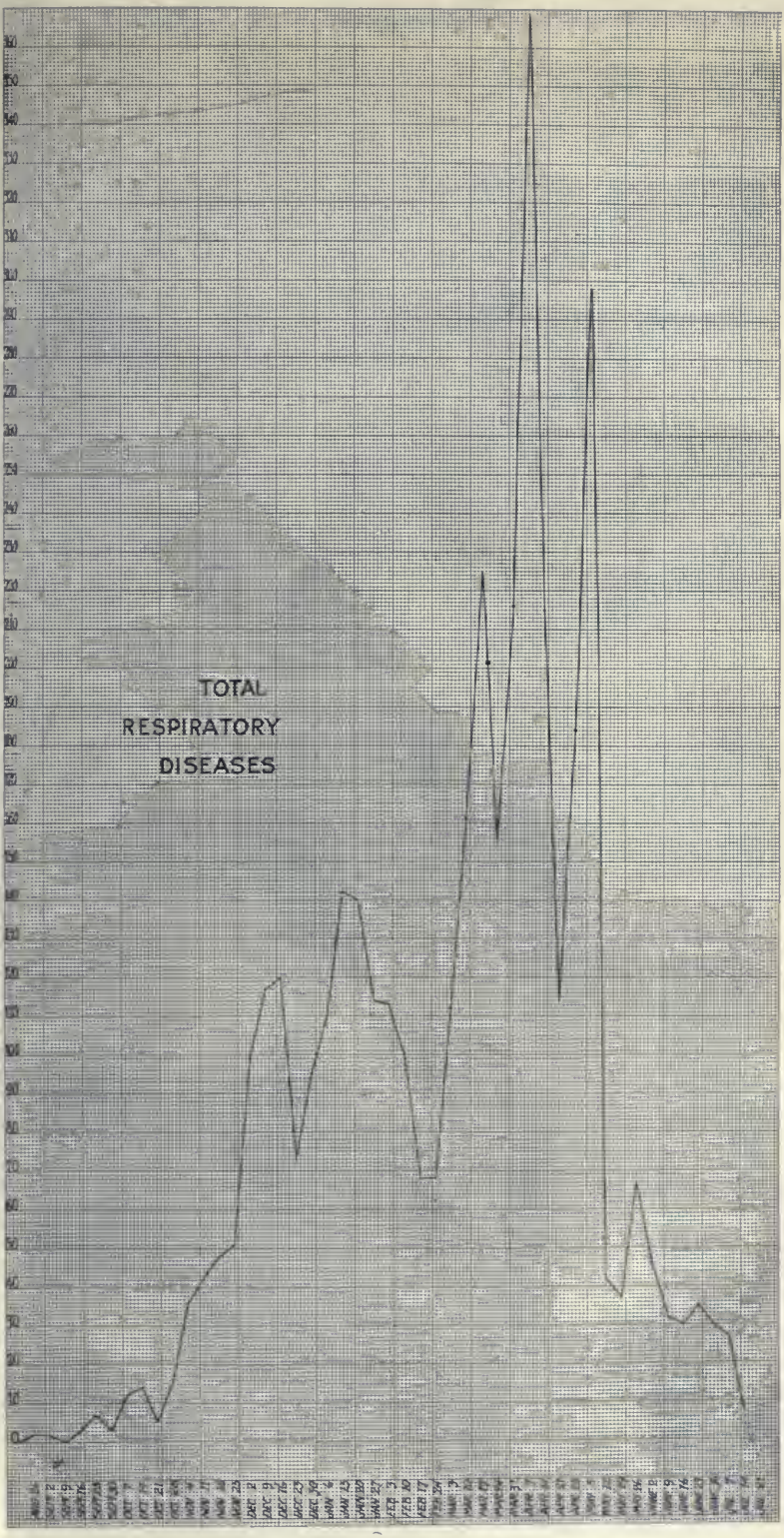


Fig. 64.—Chart VI continued.

is a rough parallelism between the high points of totals and the mortality, it is noteworthy that in the measles at least the highest number of deaths is just before the highest number of cases.

Pneumococcus cases, while fairly uniform through the period covered, tended to become less fatal. Streptococcus cases progressed upward in an irregular course with a fairly uniform mortality until April, when deaths declined, but cases increased.

The curve of measles and streptococcus infections are roughly parallel until this great rise, at a time when measles was falling rapidly. This is indicated in another place in the mortality from collected pneumonia (Chart III) during March and April.

We believe that the uniformity in the charts of measles and streptococcic infections rather indicates that they are not inseparable, for if the streptococcus were dependent upon measles, the virulence, that is, case incidence and mortality, should show a more sustained rise during the winter instead of falling very low in February.

In order that the position of other variables might be evaluated Chart IV was prepared. The important things—pneumonia, measles, pleuritis—have somewhat overshadowed other signs of infections in the camp. For example, infections of the ear and sinuses of the head are found to rise very steadily and were well established before any of the above were under way. Erysipelas, known in 2 cases to be due to the Streptococcus hemolyticus, had started before measles or pneumonia, and was present in 18 cases late in the winter, only 5 of which were in measles. The point is of some practical value as well as of academic interest to get an idea of the relationship of measles and streptococci. We feel that the streptococcus was with us very early in the autumn, and one of us examining smears from sore throats and cultures on Löffler's serum for diphtheria in September was struck with the frequency of finding enormous numbers of long chain streptococci.

III. BACTERIOLOGY

Pneumococcus.—Pneumonia type determinations were made in the laboratory either by the mouse or the new Avery method. In general, the results obtained by the two methods agreed fairly well, although the mouse method is much preferable. Up to July 1, 1918, 198 type determinations of sputum of pneumonia patients were made, divided as follows:

Type I. Number of cases	40
Mortality	7
Percentage of mortality	17.5
Type II. Number of cases	49
Mortality	4
Percentage of mortality	81
Type III. Number of cases	4
Mortality	1
Percentage of mortality	25
Type IV. Number of cases	105
Mortality	14
Percentage of mortality	13.5

These type determinations, grouped according to months, were as follows:

	1917			1918						
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
Type I....	1	3	0	4	11	14	6	1	0	40
Type II....	0	3	0	3	7	6	14	7	9	49
Type III....	0	0	0	0	0	0	0	4	0	4
Type IV....	1	10	1	7	10	23	41	9	3	105

Bacteriology of empyemas up to July 1st included the examination of 199 cases, divided as follows:

Hemolytic streptococci. Number of cases	127
Mortality	43
Percentage of mortality	33.8
Pneumococcus (type undetermined) cases	31
Mortality	14
Percentage of mortality	45.1
Undetermined. Number of cases	41
Mortality	12
Percentage of mortality	25.2

Since July 1st special studies have been made on the pneumonias and empyemas regarding the type pneumococcus from several examinations of the sputum, blood, pleural fluid, and from lung tissue and heart's blood at autopsy. These studies were made, as frequently in the past, two or more different types of organisms had been found in a single case. We have collected 59 cases of such multiple findings. These 59 cases, for purposes of discussion, may be divided into three groups:

Group I: 11 cases in which pneumococcus, Type IV, and one other type has been found, either Type I, II, or III. It is probable that in such cases the Type IV organism should be considered as a contamination from the saliva and mouth secretions, as it has been shown that this rather ill-defined group of pneumococci are normal inhabitants of the mouth flora. In these cases a second or third examination should be made, with particular care that a true lung specimen, washed free from saliva, is obtained. If on such repeated examinations Type I, II, or III are found, they should be considered the etiologic organisms. Now typing is done every third day, except when IV is found, when it is repeated on three successive days for confirmation.

Group II: 3 cases in which combinations of Type I, II, or III were found. Such cases are of extreme interest, as they are the so-called fixed types of pneumococci. So far as we are aware such cases have not appeared in the literature, and we shall therefore quote them very briefly as follows: Case I. E. B. Lobar pneumonia, Type III (July 26, 1918) and Type II (July 30, 1918) found in his sputum on two different examinations. Case II. O. D. Lobar pneumonia (June 28, 1918) with empyema (July 7, 1918). Type II in the sputum (June 28, 1918) and Type I in the pleural fluid (July 17, 1918). Case III. C. W. Lobular pneumonia, Type I (July 23, 1918) and II-A (July 24, 1918) found in the sputum on two different examinations.

Group III: 32 cases in which both pneumococcus and streptococcus were found. These are to be considered cases of double infection with a primary pneumococcus in sputum or

blood-culture, and a secondary streptococcus in pleural fluid or other exudates, such as pericardium, peritoneum, mastoid, septic joints, etc. Occasionally streptococcus was found primarily in sputum, with pneumococcus late in the pleural fluid. Six cases of empyema showed a primary streptococcus with secondary pneumococcus. In these cases pneumococcus was found in the second and third pleural tappings at the time when the pleural exudate became thick and purulent.

Special virulence tests of these organisms have been made, but not yet reported, but from clinical experience and from the percentage of carriers of cases coming into the hospital at the height of the epidemic it appears that variations in the virulence of organisms must have occurred. The increase in mortality of the second measles-pneumonia epidemic in March, referred to above, may thus be due to an increase in virulence of the streptococcus, from repeated passage through newly arrived troops. Similarly the decrease in disease rate and severity which occurred with the onset of warmer weather would appear to be associated with a corresponding decrease in virulence.

Streptococcus.—With few exceptions all organisms isolated were of the hemolytic variety. In pleural fluid, in active cases, large numbers of short and long chains of streptococcus were present in smears. Biologic tests carried on by Lieutenant Lucke, to be published, have shown that streptococci isolated from various sources are alike in their biologic characteristics.

IV. HYGIENE

1. **In Camp.**—*Depot Brigade.*—The Depot Brigade is the receiving area of the camp, in which all freshly received recruits are quartered during their first months in military service. It is during this first month or six weeks of camp life that the large percentage of these severe infections occur. The factors responsible for this high disease incidence at such times may be said to be due to a lowering of vital resistance and ability to fight infections resulting from wide deviation in practically every particular from the usual mode of life. These changes,

in the amount and quality of the soldiers' food, in their associates, their surroundings, the variety and amount of exercise, work and play, their clothing, housing, their rooms for eating and sleeping, all leave their impress on their physical and nervous well-being. As a result of such changes the men lose in weight, become easily fatigued, suffer from nervous excitement

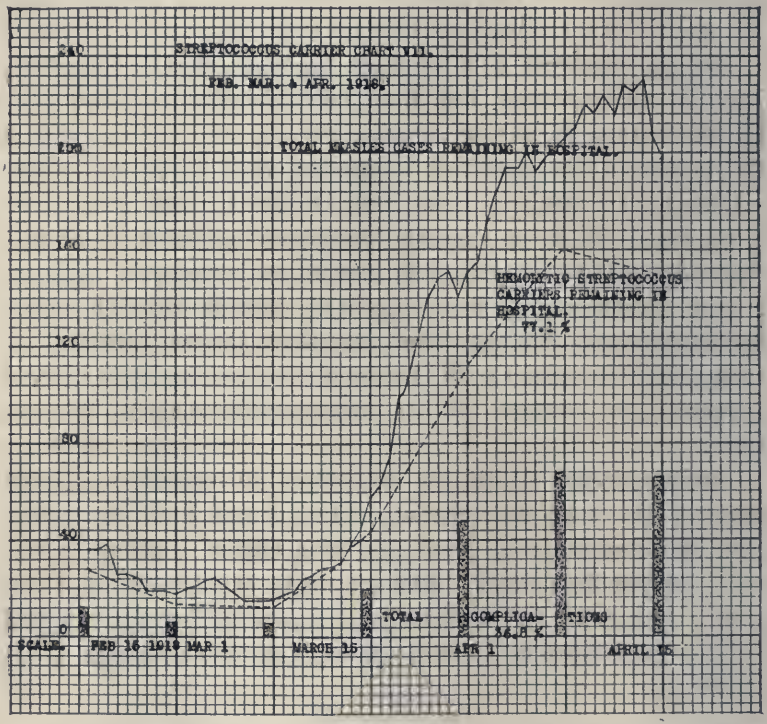


Fig. 65.—Chart VII. Streptococcus carrier. Note the high percentage (77.1) of streptococcus carriers, with a corresponding high percentage (36.8) of complications. (Contrast with Chart VIII.)

insomnia, loss of appetite, homesickness, gastro-intestinal mishaps, all of which tend to make the new recruit an easy prey to various camp infections.

Further evidence of the dissemination of infections in the Depot Brigade may be noted from a study of the incidence of streptococcus carriers. In a survey made during the early

spring, 15 per cent. of the new draft men harbored hemolytic streptococci in their throats, while within three months 83 per cent. carried them. In this respect the Depot Brigade may be considered an incubator for the cultivation of these organisms.

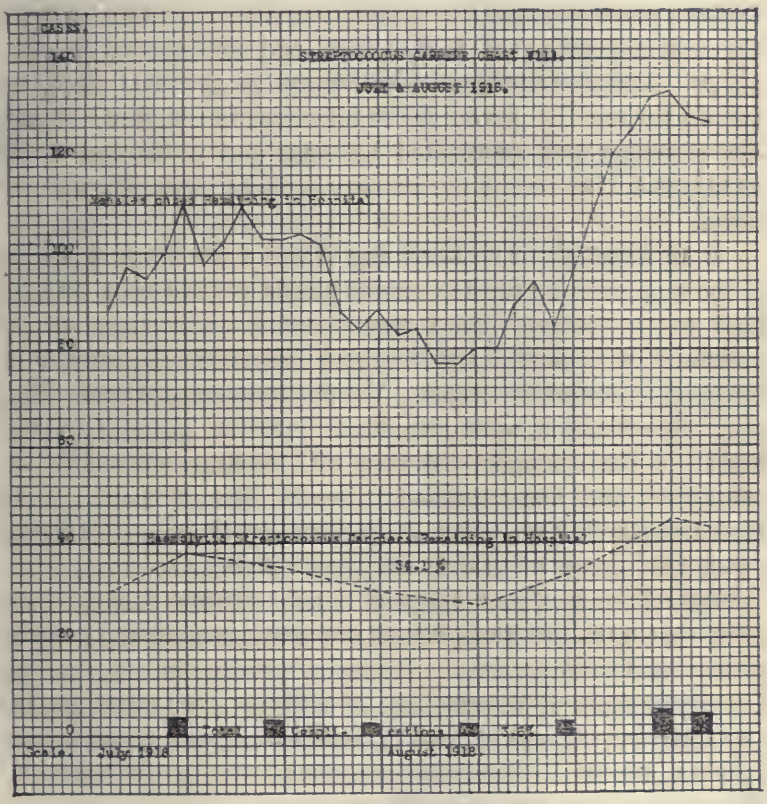


Fig. 66.—Chart VIII. Streptococcus carrier. Note the low percentage (34.1) of streptococcus carriers, with a corresponding low percentage (3.5) of complications. (Contrast with Chart VII.)

Regimental Infirmaries.—These being the points to which men report on sick call, are, in times of epidemics, because of crowding of large numbers in small stuffy rooms, areas where the spread of infectious disease occurs. Such spread results from the close crowding of 50 to 100 or more men in

a small, poorly ventilated room, breathing and coughing into each others faces, swapping cigarettes and tobacco with sputum smeared hands, and general dissemination of nasal and oral discharges.

Barracks.—Squad rooms and mess halls in barracks are fertile sources of infection, either from direct contact or from the dust sweepings, or food, water, and milk-supply in such places. Many streptococci were found in the dust of those barracks where the percentage of infections ran highest. When dry sweeping was supplanted by soap and water and disinfectant solution scrubbing, disease incidence was sharply cut down.

2. **In Hospital.**—The Receiving Ward of the hospital stands in the same relation to the General Wards as the Depot Brigade does to the general camp organizations, and unless special measures of cubicling and masking are used, the spread of infection undoubtedly occurs. Various measures for preventing such dissemination were introduced into the hospital at the height of the epidemic, together with separate entrances for contagious and non-contagious diseases, and, without doubt, these measures have been of material assistance in cutting down the spread of disease from such source.

General Medical and Surgical Wards.—It was early recognized that cross infections would probably occur in the general medical and surgical wards. However, with the introduction of modern methods of isolation, use of cubicles, gowns, and masks, and later by the segregation of measles and respiratory cases into streptococcus carrier and non-carrier wards, the incidence of cross infections was markedly reduced.

Hospital Personnel.—The personnel of the Base Hospital consists of officers, nurses, and enlisted men. It was observed that while the disease incidence of the hospital was quite high, the mortality was extremely low, there being only one death in an officer (pneumococcus-meningitis), no deaths in the nurses, and only three deaths in the enlisted men. The rate of disease was much higher in the enlisted men than in the nurses and officers, and, in general, these men, like the troops

generally in this camp, were drawn from rural sections more than from urban communities. It is interesting to note further that organizations such as the Medical Corps, Quartermaster Corps, Cooks and Bakers School, and similar organizations, not exposed to severe outdoor drill and exercise, with exposure to cold and wet, suffered much less from respiratory diseases than the regular line organizations. These observations hint at some of the sources of the diseases under discussion.

V. CLINICAL PICTURE

In the paragraphs above the striking features of the clinical picture have been described. However, there are a few points which it might be profitable to discuss further.

Pneumonitis.—All varieties represented.

Typical lobar, with rusty sputum, with crisis on the seventh to eleventh day. There were either small localized patches of consolidation or a large massive pneumonia involving all lobes of both lungs.

Typical broncho- or lobular pneumonia, with scattered areas of consolidation. At times there was considerable difficulty in differentiating between severe acute bronchitis and multiple small areas of bronchopneumonia.

Atypical lobar pneumonia, without chill or rusty sputum, with long prodromes of cough and general lassitude, without frank signs of consolidation. In many cases the pneumonic consolidation was an incident, the disease being a true pneumococcus or streptococcus sepsis with secondary pleuritis, pericarditis or polyserositis, with many complications—otitis media, mastoid, erysipelas, septic arthritis, cellulitis, meningitis, nephritis, etc.

Onset.—At times this was prolonged, following a week or two of "cold," "cough," "sore throat," general lassitude and slight fever, at times acute, following definite history of exposure, fatigue, wetting, chilling, etc., from lying in snow on rifle range; passing the night in cold wet practice trenches; after guard duty in the rain when the slickers had become drenched through; after long hikes through snow and mud with soaked

shoes and stockings. Sometimes the condition developed insidiously without apparent chill or pain, the soldier insisting he was not ill. More often it was fulminant, distressing, with unbearable pleural pain, panting respiration, sometimes with profound weakness, almost to collapse and coma.

Course.—This was sometimes short, with prompt crisis within a day or two of admission, with miraculous change from apparent critical illness to comparative ease and comfort. Sometimes the course was short, but with increasing severity, with rising temperature, pulse and respiration, deepening cyanosis, rapid grunting breathing, tympanites, restlessness, finally with thready pulse and deepening coma, until death. Often complications developed, a to-and-fro friction over the heart from beginning pericarditis, increasing abdominal distention and tenderness from peritonitis, deepening blush about nose, cheeks, ear, and mouth from erysipelas, severe joint and limb pains from septic arthritis and cellulitis, ear and bone tenderness, with enlarged tender cervical glands from otitis media and mastoid disease.

Convalescence.—Recovery was often prolonged and tedious, convalescence being accompanied by much loss of weight, cachexia, and inanition. Frequently, rapid irregular heart, difficulty in standing and walking, tremors, fibrillations, vasomotor clamminess of palms and soles, dyspnea on slight exertion were present for a long time. Intercurrent infections, slight temperature rise, cough, red throat; occasionally severe late sequelæ, erysipelas, joint abscess, cellulitis of face and scalp, septic mastoiditis with thrombosis of lateral sinuses or brain abscess; not infrequently multiple exanthemata complications, mumps, chicken-pox, German measles; these complications were very common during this period. The discharge slip of many patients appeared much like a glossary of the communicable diseases.

Pleuritis.—This was radically different from the usual well-known types of para- or metapneumonic empyema. In many cases the pleuritic process occurred very early, the disease being ushered in often insidiously without symptoms; often severely acute, with urgent pleural pain, cyanosis, grunting dyspnea,

marked prostration, and overwhelming toxemia; often primary without pneumonitis; often the only prominent symptom of a general sepsis. The early, clear, serous fluid (containing streptococci) later turned into a thick creamy exudate, with a corresponding improvement in the clinical condition of the patient. The treatment of the acute severe empyemas was the most difficult problem of the year's experience to solve. However, the basic problem is neither the medical nor surgical treatment of empyema, but the general streptococcus problem, viewed from the epidemiologic and prophylactic standpoints. In this sense the problem comprehends, as Colonel Welch has put it, "the starting-points and agencies concerned in spreading these streptococcus infections in camp, hospital, and civil communities; the carrier problem; the rôle of pre-existing infections, etc."

In general, the clinical picture may be said to be that of pneumonitis, described above, with a few exceptions, particularly the local chest signs and symptoms. In these patients the onset was often even more acute, the course more severe. There were noted intense chest pain, with inspiratory exacerbations, often constant and deep-seated, asymmetry of the afflicted side, with unilateral fulness and diminished excursion. Sometimes, however, the pleura was quite packed with pus, but without subjective complaints.

The difficulty of physical examination has been mentioned. Localized or extended dulness, approaching flatness, was always suspicious and usually confirmed by needling or *x*-ray. However, small anterior pockets, or pockets between mediastinum and lung, or between lobes, was always difficult to diagnose, and even more difficult to reach.

Measles.—All varieties were represented, from the mildest to the most severe.

Of particular interest were the cases coming in acutely and severely ill with marked respiratory symptoms, cough, cyanosis, amounting at times to blue-blackness of the face and ears, often with complicating pneumonia and empyema. In the second epidemic death from pneumonia or streptococcus

sepsis occurred often before empyema had time to develop. These cases of measles with associated streptococcus sepsis with such very high mortality are among the most severe types of disease we have ever seen, being only comparable to the most profound cases of general sepsis and profound toxemia.

Streptococcus was present in all of the above, and in all probability was the predominating factor in them and was responsible for the majority of the severe symptoms. Hemolytic streptococci were isolated from the typical pneumonias and empyemas, middle-ear and mastoid diseases, erysipelas, and many other complications which have been mentioned.

It should be stated that in our opinion the clinical picture of pneumonitis and pleuritis has so overshadowed the clinical picture of other streptococcus infections that the latter have very nearly been lost sight of. In this connection we would emphasize the importance of severe streptococcus sore throat with purplish redness, edema and prominent lymph-follicles, streptococcus laryngitis and trachitis, with hoarseness and hacking, prolonged cough, acute middle-ear and accessory head sinus diseases, sudden acute "grips" with prostrating headache, backache, joint and limb pains, red throat, etc. Accompanying the above there were slight temperature rise and feeling of lassitude and tire, and later the characteristic and protracted convalescence accompanied by loss of weight, pallor, and "gray feel and look," cough, repeated colds, and weakness. Fully 75 per cent. of the hospital personnel fell victim to the above "benign" type of streptococcus diseases, at one time or another, during the epidemic.

VI. METHODS ADOPTED TO CONTROL THE EPIDEMICS

Camp

It became evident early in the course of the epidemics that the problem of their control was not confined to the hospital, but was a problem of the entire camp, even the extra cantonment zones, and its solution demanded the close co-operation of all medical organizations concerned. The necessity of wide-reaching sanitation and prophylactic measures became the more

urgent because of the very high mortality in the new men coming into the hospital, and the fact that many of them, in spite of all treatment, succumbed in a few days to these severe and virulent infections.

Believing that the control of this situation demanded the most far-reaching measures, our attention was first turned to the new recruits at the time of entrance into the Depot Brigade. For the improvement of this situation and for the control of some of the factors spoken of above (Paragraph IV) it was recommended that a Detention Camp be started. The following abstract of report, submitted to the Surgeon General, is indicative of the situation at that time:

"3. **Detention Camp.**—The portal of entry of men and infection to the camp is, in most cases, the Depot Brigade; and it is here, owing to close intermingling of fresh recruits, assignment by the personnel office of small groups of new men to all companies, too rigorous and prolonged drill schedules, lack of knowledge of personal hygiene and methods of spread of communicable diseases, that the soil is prepared for future infection, and wide-spread dissemination results. It would seem that the Depot Brigade bears the same relation to the general camp as the receiving ward of a hospital to the general wards, and methods of observation and segregation are imperative in both instances.

"*Recommendation.*—It appears highly desirable that a specially constructed incoming detention camp be established in each cantonment for the purpose of segregation and observation of drafted men. This camp should be composed of small units of from 20 to 30 men, who shall mess, sleep and drill together, so that internal quarantine of such small units may be established if necessary. This incoming detention shall be maintained rigidly for three weeks, during which period recruits shall be given their typhoid and small-pox vaccinations; watched carefully in small isolated units for early recognition and separation of contagious diseases; given very gradually increased exercises and drill formations; instructed daily in a practical way in personal hygiene and in methods of spread and prevention of communicable disease. The detention camp shall be surrounded with a high wire fence to assist in preventing social intercourse with the remainder of the camp as well

as with the outside civilian population, and shall contain sufficient regimental infirmaries. In addition, a special building shall be constructed to house a bureau with adequate personnel and laboratory equipment, for the purpose of making clinical and statistical studies of the new men. These studies might include such things as detention and isolation of streptococcus carriers; studies in prophylactic streptococcus vaccination; weight studies, etc. A special officer shall be assigned as bureau supervisor to inaugurate and correlate this work.

"An out-going detention camp shall likewise be established to house the same number of men as the incoming camp. Men being transferred to other camps or to points of embarkation shall be detained here for three weeks. During such time observations and records similar to those made in the incoming camp shall be made. The men's service records and other paper work incident to their departure might also be completed at this time."

After new troops had been in the Depot Brigade for a period of from one to three months they were transferred to the more permanent organizations of the division or the camp, and at times of epidemics report to the Regimental Infirmaries for sick call. In order that the highest degree of efficienty of the Regimental Infirmaries could be obtained, and after considerable study and observation of their methods of work, the following recommendations for the work of Regimental Infirmaries were made:

"4. **Regimental Infirmaries.**—To a very high degree the success or non-success of the medical services at base hospitals depends upon the work of the regimental infirmaries and regimental surgeons. These places may be considered as the out-patient departments of the base hospital, and should be subjected to the same careful organization and inspection as the latter.

"*Recommendation.*—Standardization and uniformity in the work of regimental infirmaries shall be developed. This should include uniformity in the taking of sick call; daily inspection of the entire command; uniformity in the minimum requirements of the examinations, viz., examination of one soldier at a time in a closed room; taking and

recording of temperatures; each soldier stripped to the waist; his throat inspected with the aid of a tongue depressor; masking of soldiers while waiting for examination to prevent the spread of respiratory disease in the infirmary; establishment of a small observation ward of from 6 to 12 beds; establishment of a small laboratory in connection with the ward for clinical work. At the weekly conference with the regimental surgeons, the Division Surgeon, the Division Sanitary Inspector, and all regimental surgeons except the officer of the day shall be expected to attend. At times of new increments of drafted men there shall be arranged either an additional staff for this work, or the examination shall be put at a time not to conflict with the daily sick call and daily inspection."

During their daily routine and particularly when indoors, between the hours spent in sleep in the squad rooms and at mess, the spread of communicable disease occurs probably to a greater extent than when at drill, hike, and play outdoors. To control this situation as far as possible the following recommendations were made:

"6. **Communicable Diseases.**—*Recommendation.*—The masking method inaugurated at Camp Grant for the control of communicable diseases at the Base Hospital shall be extended into the work of the regimental infirmaries, particularly at the time of taking sick call, where hundreds of men congregate in small stuffy corridors waiting for examination. A sick soldier listed for transfer to the hospital shall replace his mask after the examination and wear it constantly until he reaches his bed in the cubicled ward (Figs. 67 and 68). Throughout the detention camp and in quarantined barracks in general a cubicle system for the men's cots or a simplification of same shall be adopted (Figs. 69–71). The cubicle method should be extended in these localities to the mess by stretching small sheets, 30 inches in width, down the center of the mess table, 6 inches from the top (Fig. 72). This will prevent to some degree infection being spread across the narrow table. The men shall be assigned in their own groups to permanent places in the mess room. This method of table cubicling and permanent mess assigment shall likewise be installed in the central mess of the base hospital" (Figs. 73 and 74).

Fig. 67.—Arrival of ambulance at receiving ward, showing masking of patients.

Fig. 68.—Removal of litter patient (masked) from ambulance.

Fig. 69.—Squad room in barracks of 159th Depot Brigade, showing bed cubicles in place.

Fig. 70.—Soldiers asleep on adjacent beds, protected by cubicles and alternation of head and feet.

Fig. 71.—Soldier asleep in cubicled bed.

Fig. 72.—Mess room in barracks of 159th Depot Brigade, with cubicles suspended down center of mess table. Note bottom of sheeting is too far above top of tables, and should not be over 6 inches.

Fig. 73.—Central mess, Base Hospital, with cubicled mess tables.

Fig. 74.—Patients at central mess, Base Hospital.

In order that the entire camp contagious disease situation could be studied and analyzed and because of the urgency of the situation in general a Board of Officers was appointed by the Commanding General, April 5th, in accordance with the following order:

"Headquarters Camp Zachary Taylor,
Louisville, Kentucky,
April 5, 1918.

Special Orders
No. 95

Extract

2. The verbal orders of the Commanding General of April 1, 1918, designating

Lt.-Col. Luther R. Poust, M. C.,
Major W. W. Hamburger, M. R. C.,
Major John H. Telfair, M. R. C.,
Capt. David M. Roberg, M. R. C.,

as Board of Officers to investigate, report upon, and submit recommendations with a view to preventing the importation and spread of contagious diseases in this camp through the 159th Depot Brigade, are hereby confirmed and made of record.

By command of Major General Hale.

W. H. Bell,
Major, Infantry, N. A.,
Camp Adjutant."

As a result of the deliberation of this Board the following recommendations were made:

"Office of Camp Surgeon,
Camp Zachary Taylor, Ky.,
April 4, 1918.

Proceedings of a board of Medical Officers convened by verbal order of Camp Commander herewith enclosed.

Per verbal order of the Camp Commander a board composed of the following officers will meet at the earliest possible time

to investigate and recommend referable to insanitary conditions in the recent draft:

Lt.-Col. L. R. Poust, M. C., N. A.,
Major Walter Hamburger, M. R. C.,
Major John H. Telfair, M. R. C.,
Capt. David M. Roberg, M. R. C."

"The Board met Tuesday, April 2d, at 3.00 P. M.: present, all members. Adjourned at 5.00 P. M. Board convened at 9.00 A. M., Wednesday, April 3d, and adjourned at 12.00 noon. Board convened at 9.30 A. M., Thursday, April 4th, and adjourned *sine die* at 12 noon.

The following recommendations are made:

1. That sheeting 36 inches high be suspended over median lines of mess tables. The bottom of sheeting to be 6 inches above top of table. Detachable (see Fig. 72).

2. That sheeting 2 feet high be installed on one side of each bed, uprights to be attached to head and foot of bed, connected by wire from which sheeting will be suspended. Bottom of sheeting to be tied to bed rod. Detachable (see Figs. 69–71).

3. Men in each company to be separated into five groups according to squad room occupied; each group will remain by themselves absolutely except during outside formations. To this end certain mess tables will be allotted or assigned permanently to each group. Three men or less are to be seated to a section on one side of a mess table.

4. Battalion Surgeons will instruct the men while eating in the purpose of the cubicle system. Instructions to continue for one week.

5. That a guard be placed in each company lavatory to prevent unnecessary loitering.

6. Y. M. C. A. buildings, K. of C., and Post Exchanges in Depot Brigade to be closed after retreat. To remain open during the day to members of unquarantined organizations. Inside entertainment to be replaced by outside or open-air entertainment for the benefit of unquarantined organizations; quarantined organizations to remain in quarantine.

7. That no person or persons be allowed to leave main road

passing through Depot Brigade except authorized persons delivering or receiving parcels. This to be enforced by guards.

8. That 1st Prov. Training Regiment be quarantined together with 515th Engineer Service Battalion and that this entire area be made a detention camp. No one to be allowed to enter or leave this area except authorized persons delivering or receiving parcels.

9. That the period of detention be increased from two to three weeks from the time of entrance of last quota.

10. That old draft of 2500 men be transferred from the 159th Depot Brigade to two organizations of the Division (as the 335th and 336th Infantries), these men to be rigidly quarantined apart from permanent personnel for a period of two weeks.

11. The above measures are to be considered merely as emergency steps to meet present existing conditions until such time as an adequate detention camp accommodation can be secured. The present unsatisfactory condition is due, among other things, to the assignment of incoming draft to various organizations in the Depot Brigade, thus distributing most widely communicable diseases.

It is the opinion of this Board that the whole problem of a permanent detention camp be carefully considered. The Board strongly advises that a permanent detention camp be provided.

(Signed) L. R. Poust,
Lt.-Col. M. C., N. A.,
President."

In addition to the above it was found desirable to recommend rigid attention to sweeping and cleaning with disinfectant solutions, because streptococcus had been found repeatedly in dust of barracks, especially in the case of one Field Hospital, where 90 per cent. of personnel had acute infections.

Methods Adopted in Hospital

Receiving Ward—Use of Masks and Cubicles Throughout Hospital.—The Receiving Ward was arranged with cubicles for

the reception and segregation of patients (Fig. 75). Preliminary paper work was taken down directly on typewriters, both patients and clerk being masked continuously (Fig. 76). After examination by the receiving officer patient is assigned to proper ward, continuing to wear mask until placed in bed between cubicles (Fig. 77). On communicable disease wards officers, nurses, and orderlies are masked and gowned at all times, and patients when up and going about ward or to latrine

Fig. 75.—Interior of receiving ward, showing arrangements of cubicles.

wear masks. Convalescent patients take their meals for most part on their own wards, but occasionally, because of crowding, etc., go to the central mess, and here are assigned to separate permanent table places, each ward by itself, with sheets stretched down center of mess table (see Figs. 73 and 74).

Medical Treatment.—Within the limits of this report it would not be profitable to discuss at length all the details of the treatment of these cases. We shall therefore confine it to the following points:

Fig. 76.—New patients (masked) waiting in receiving ward cubicles, while Sergeant (masked) types admission cards.

Fig. 77.—Cubicled ward.

1. **Routine Treatment.**—*Service Orders.*—The following Service Order for the treatment of all pneumonias was issued early in October:

"Base Hospital, Camp Zachary Taylor, Louisville, Ky.,
October 12, 1917.

ORDER No. 6

MEMORANDUM ON ROUTINE CARE—PNEUMONIA PATIENTS

1. Push fluids—especially lemonade, orangeade, milk, and plain water.
2. Tincture of digitalis, 20 minims each four hours, for three days.
3. Open all windows near patient.
4. Give low cleansing enema P. R. N.
5. For temperature of 104° F. or over tepid sponge-bath each four hours.
6. Codein sulphate, $\frac{1}{4}$ to $\frac{1}{2}$ P. R. N., for severe cough.
7. Temperature, pulse, and respiration each four hours.
8. $1\frac{1}{2}$ drams (7 c.c.) 10 per cent. potassium acetate solution each four (4) hours.
9. In case of collapse or delirium or any untoward symptoms, call Ward Surgeon immediately."

With the progress and increase of the virulence of the infections, and in view of the postmortem findings of cardiac dilatation as the immediate cause of death, special attention was given to the use of digitalis. Through the courtesy of the Department of Physiology, of the University of Louisville, the various digitalis preparations on hand were standardized and the preparations of the highest potency were used as far as possible. The following memorandum regarding the use of digitalis was issued:

"Base Hospital, Camp Zachary Taylor, Louisville, Ky.,
December 17, 1917.

ORDER No. 4

MEMORANDUM ON DIGITALIS

1. Tincture of digitalis (Squibb) should be started immediately on all lobar and bronchopneumonias as soon as

the diagnosis is established. In cases of high temperature and clinical lung involvement without positive lung signs, digitalis should also be given.

2. *Method of Administration.*—In cases diagnosed early and without urgent cardiac distress, good pulse, and little cyanosis, give tincture of digitalis, 30 minims (2 c.c.) every six hours: 9.00 A. M., 3.00 P. M., 9.00 P. M., 3.00 A. M. for forty-eight (48) hours.
3. If diagnosis is made late with great cardiac distress, marked cyanosis, dyspnea, etc., give 60 minims (4 c.c.) at 9.00 A. M., 3.00 P. M., 9.00 P. M., and 3.00 A. M. for twenty-four (24) hours.
4. Digitalis should be measured out accurately in minim glasses.
5. If digitalis is not absorbed as evidenced by no evidence of digitalization (slowing of pulse, improvement of general condition, breathing, cyanosis, and character of pulse), give ampules of digipuratum, strophanthin, or ouabain intravenously.
6. If digitalis effect has been obtained, do not repeat until new evidence of cardiac failure. If urgent, give intravenously; if not urgent, tincture by mouth in same as original dosage.
7. If digitalis is not effective at any time and particularly in case of collapse, give camphorated oil, 15 to 20 minims, hypodermically, every half hour to two to four hours as indicated. Caffein, 2 grains, and strychnin, $\frac{1}{30}$ grain, may likewise be given to asthenic, toxic, or collapsed patients if without delirium or central nervous system involvement.
8. Venesection in marked cyanotic plethoric individuals with high, bounding pulse may in certain instances be of value.
9. Oxygen tanks may be obtained in emergency from the Head Surgery Building."

December 20, 1917, in view of the rapidly increasing com-

plications in measles, Memorandum No. 5, regarding the care and treatment of these cases, was issued:

"Base Hospital, Camp Zachary Taylor, Louisville, Ky.,
December 20, 1917.

ORDER No. 5

MEMORANDUM ON CARE AND TREATMENT OF MEASLES CASES

1. Care on entrance into ward:
   Bed warm.
   Protection during giving of bath.
   Enema if bowels have not moved.
   Cathartic pills.
   Mouth, nose, and teeth hygiene.
   Specimen of urine to laboratory.

2. Care during febrile and eruptive period:
   Semiliquid or soft diet.
   Sponge-bath for temperature of 103° F. or over.
   Push liquids—water, milk, diuretics.
   Medication for adequate rest, sleep, and control of cough.

3. Care during decline of fever and convalescence:
   Full diet as soon as possible; nourishment between meals.
   Daily alcohol rubs.
   Prolonged rest in bed—getting up gradually in forenoon and afternoon.
   Protecting clothing while getting up, not to put patient to work in corridors.
   Sufficient food.

4. Treatment of complications:
   Early diagnosis of pneumonia, with early digitalis therapy.
   Early diagnosis of otitis media, empyema, mastoid disease, etc.

5. Ventilation of ward:
   Temperature 65 to 70 degrees.
   Ventilators open.
   Good air circulation.
   Windows open from top only.

6. Care in transfer to other wards:
   Ample protection with blankets, litter or wheel chair, if unable to walk.

7. Discharge from hospital:
   Minimum of twenty-eight (28) days.
   Back to normal weight.
   Seen by special examiner before discharge.
   Free from infective symptoms.
   Free from complications.
   Normal specimen of urine."

With the advent and segregation of the empyema cases a routine was established, covered in orders for the observation and care of these cases, and was published February 1, 1918:

"Base Hospital, Camp Zachary Taylor, Louisville, Ky.,
February 1, 1918.

ORDER No. 15

MEMORANDUM ON TREATMENT OF EMPYEMA

1. Every bronchopneumonia and lobar pneumonia, severe sepsis, continued high temperatures without demonstrable cause, severe continued dyspnea, particularly when accompanied by a sense of marked discomfort or pain on breathing, fulness or tightness in the chest, shall be considered *potential empyema*, and be observed constantly with this possibility in view.
2. Each potential empyema shall be *x*-rayed within forty-eight (48) hours of admission, providing patient's condition permits.
3. Each potential empyema shall be seen by the special empyema surgeon within forty-eight (48) hours after admission for consultation regarding exploratory thoracentesis.
4. A positive thoracentesis shall be followed immediately by potain, withdrawing as much fluid as compatible with patient's condition. A specimen of such fluid each time obtained shall be sent to the laboratory for examination.

5. Proved cases of empyema shall be examined daily, and *x*-rayed and tapped at least every third day. Upon the fluid becoming opaque and of cream or purée consistency, patient shall be transferred to Surgical Service for continuous drainage with suction apparatus, unless ordered otherwise."

2. **Withdrawal of Fluid.**—In a large number of cases the withdrawal of even a small amount of fluid was followed within a period up to forty-eight hours with partial or complete collapse of the patient. The explanation of these cases may be sought in either the mechanical withdrawal of fluid or, in the acute stages, of an increased absorption of toxic and other septic products from the inflamed lung and pleural surfaces. To control this we have, within recent months, followed all withdrawals of fluid with injection of an equivalent amount of air or nitrogen gas. This is accomplished by either reversing the potain pump and pumping air into the chest or by the use of the Murphy pneumothorax apparatus. By such methods the pain and discomfort complained of shortly after or during the removal of fluid is very promptly relieved. The introduction of this air, or gas, acts as a buffer or support for the lung and pleura, and due to its gradual absorption in the course of a few days allows the lung to expand gradually.

3. **Time of Election for Surgical Interference.**—By the middle of January we had reached the decision that early operation in empyema was a mistake and that delayed operation was the operation of choice. This conclusion was arrived at after many perplexing experiences and after considerable study, and was so stated in orders of February 1st, and published March 30th, in the Journal of the American Medical Association, as follows:

"5. The character of the empyema fluid gradually changes, becoming progressively more turbid and heavier. The greatest benefit from surgical interference is obtained by delaying operation until the fluid becomes opaque, greenish gray, and of cream or purée consistency. Operations instituted earlier or later are of less benefit."

More recently additional observations, based on analyses of the temperature, pulse, respiration, leukocytes, and blood-pressure curves, have been made, confirming our original belief.

From an analysis of these curves in a series of over 90 cases the cases may be divided into three groups:

First, simple fibrinous or serofibrinous pleurisy with sterile fluid or with none at all, and with prompt recovery within forty-eight to seventy-two hours after admission. These constitute about 20 to 25 per cent. of the cases analyzed.

Second, true severe empyema, starting acutely with high temperature and chest pain, with rapidly developing fluid, passing through the three stages of serous, seropurulent, and purulent, the majority eventually recovering following surgical intervention. These constituted about 65 to 70 per cent. of the cases analyzed.

Third, the foudroyant fulminant cases, probably general septicemia, entering with chests full of fluid and dying within forty-eight to ninety-six hours in spite of all treatment. These constituted about 10 to 15 per cent. of the cases analyzed.

The first group of simple pleurisies with sterile fluid are characterized by the prompt permanent drop (crisis) of temperature, pulse, and respiratory rate, and the low white count (4000 to 5000).

The second and largest group of empyemas pass through a rather definite cycle of events, more or less similar in all.

The development of empyema in this group may be considered to occur in three stages, namely:

Stage I: Acute stage, preceding the development of pleural fluid.

Stage II: The development and demonstration of serous or seropurulent fluid.

Stage III: The development and demonstration of "creamy" pus.

The temperature, pulse, respiration, and leukocyte count in these stages are as follows:

Stage I: Acute stage, preceding the development of pleural fluid:

Temperature, 103°–104° F.
Pulse, 110–112.
Respiration, 34–36.
Leukocytes, 12,000–15,000.

Stage II: The development and demonstration of serous or seropurulent fluid:

Temperature, 100°–101° F.
Pulse, 100–110.
Respiration, 30–34.
Leukocytes, 14,000–18,000.

Stage III: The development and demonstration of "creamy" pus:

Temperature, 99°–100° F.[1]
Pulse, 100.
Respiration, 30.
Leukocytes, 20,000–30,000.

Stage IV: Following the development of "creamy" pus the leukocytes generally fall.

In general, with the onset and development of empyema the *temperature*, *pulse*, and *respiration fall*, the leukocytes *rise* (Chart IX). Synchronously, there is an abatement of the acute severe symptoms, and a clinical improvement in the patient's condition, which fact accords with the conception that pleuritis in these infections is evidence of good combative powers of the patient.

The pulse usually parallels the temperature and respiration, although it is often relatively rapid, that is, temperature of 99° F., with pulse of 110.

In the favorable cases there is apt to be some drop in the leukocyte count following each withdrawal of fluid, with a subsequent rise thereafter, coincident with the thickening and accumulating of pus.

In the fatal cases the pulse and respiration are of greatest importance, continuing to *rise*, although the temperature may

[1] About one-half the cases show a slight *secondary* rise in temperature as the pus thickens, although the pulse and respiration may remain unchanged, or even drop.

fall (Chart X). Failure of the pulse to fall with the usual drop in temperature, and particularly an *increase* in *pulse-rate* through all three stages are almost certainly indicative of a fatal outcome.

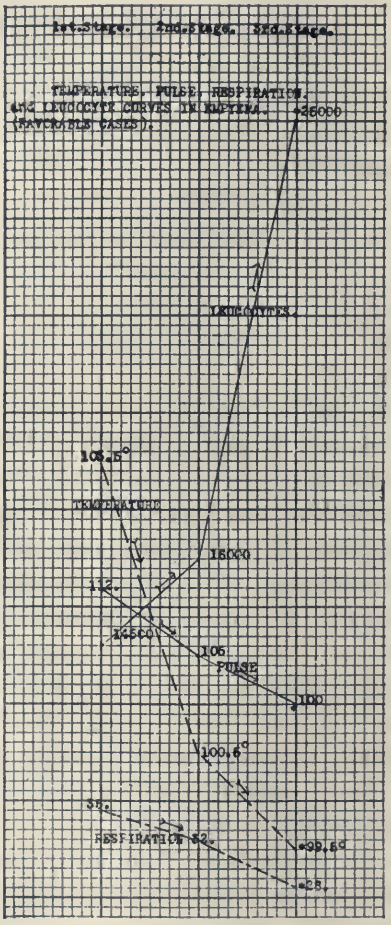


Fig. 78.—Chart IX. Note the fall of temperature, pulse, and respiration and rise in leukocytes in *favorable* cases of purulent pleuritis. (*) Time of choice for thorocotomy at end of third stage. (Contrast with Chart X.)

The leukocytes, in fatal cases, may continue to rise after the establishment of thick pus. The highest count obtained (70,000) occurred under such conditions.

The blood-pressure is of little value. There may be a slight increase in the seropurulent stage. There is little change in fatal cases.

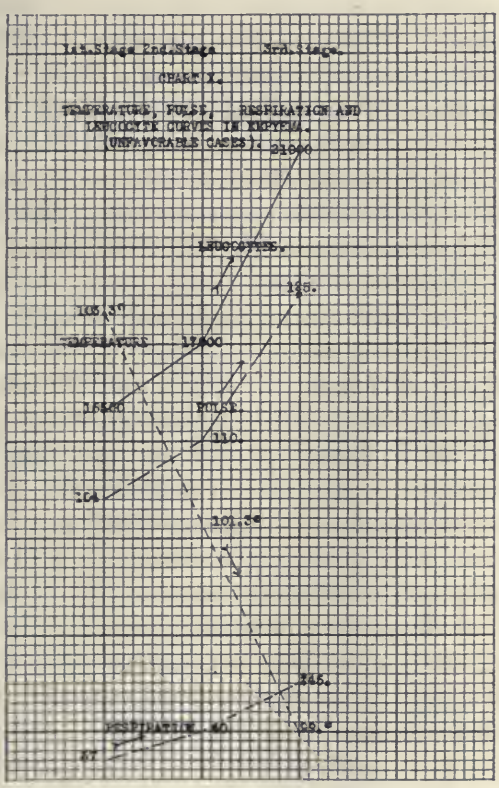


Fig. 79.—Chart X. Note the rise in pulse and respiration in *fatal* cases of purulent pleuritis. (*) Urgent indication for surgical interference. (Contrast with Chart IX.)

Time of election for surgery, four criteria:

A. The establishment and demonstration of "creamy" pus.

B. The lowest point in the temperature, pulse, respiration, and leukocyte curve (*after* the fall of the secondary rise in temperature and *before* any increase in pulse or respiratory rate).

C. The lowest point of the leukocyte curve, if possible,

waiting for the drop following the development of pus, *although failure to drop with rising pulse are urgent indications for surgery.*

D. In general, delaying operation as long as possible, providing the patient's clinical state is satisfactory, but not delaying too long, until secondary toxic symptoms develop. *Probably the pulse-rate is of maximum value as a guide.*

An additional surgical method advocated early in February was the use of continuous drainage with suction, either with a Brewer tube and Chapman water pump or some similar apparatus. A third factor of importance is the use of Dakin solution, which is being used in conjunction with intermittent drainage through the Brewer tubes.

4. **Diet.**—A diet rich in utilizable carbohydrates was introduced early in April for the prevention, as far as possible, of the marked cachexia, which was so striking a fixture in the long-standing empyema cases. However, such diets as well as several modifications, including the Coleman typhoid diet, were not very well accepted by the patients, the majority of them complaining of an overamount of sugar, sweetening, and other carbohydrates. It was finally found that practically each diet had to be adapted to the individual patient, but in general a diet rich in carbohydrates was found possible. Later protein was also increased, until finally a generous mixed diet containing from 3000 to 4000 calories became a routine on the convalescent empyema wards.

5. **x-Ray.**—It is hardly necessary to speak of the inestimable value of fluoroscopic and plate examination in the early recognition of empyema. It is due to the *x*-ray that objective evidence of the extreme rapidity (within twenty-four hours) of the filling of the pleural cavity with pus was obtained. As a surgical guide for the location of pus, and for the diagnosis of complications in the postoperative cases, one cannot say too much of its value.

6. **Convalescence (Disposition).**—The factors of greatest importance during convalescence seem to be an adequate diet of rather large proportions, fresh air and sunshine, and very gradual return to activity, such as short walks, hikes, and drill. The value of fresh air was clearly demonstrated by the better-

ment of the bed patients by moving them from the ward to the porch. Late complications—such as septic joints, tuberculosis, and chronic abscesses—are not infrequent, and special measures in individual cases were taken. Of the 304 cases of pleuritis up to September 1st, 70 cases have died, 76 cases have been discharged from the Service, 18 cases have been accepted for Domestic Service, and 6 cases have been returned to full duty; 33 are still in the hospital. The decision as to the advisability of discharging these pleuritis cases is most difficult, as the majority of these patients, although entirely free from complaints, with normal pulse and temperature, and firm healing of the chest wound, without complications of any kind, often remain from 15 to 45 pounds under weight. Such cases we believe should be accepted either for Domestic Service, or discharged from the Service entirely. This conclusion is based on the fact that unless these patients have entirely regained their normal weight their resistance is low and they remain fertile soil for new infections. Second, although they may have regained their full weight, many complain of weakness and easily tire, and are not fit for full duty. Third, even though they may have completely recovered, these boys have already suffered very greatly in their military career (in the serious cases it has been a miracle that they have recovered at all), and it would seem that after six to ten months of hospital life, with the pain and discomfort and patience entailed therein, that these boys have already performed their full duty to the government.

VII. RECOMMEND MEASURES FOR FUTURE CONTROL

Camp.—There is very little to add regarding measures for future control that have not been already spoken of. The establishment of a Detention Camp would seem to be the *sine qua non* for the ultimate control at the source of these infections. During this period the Detention Camp would separate all new recruits into measles immunes and non-immunes, into streptococcus carriers and non-carriers. In addition, during this period they could receive prophylactic vaccination against pneumonia and streptococcus, troops from the South examined

for hookworm and malaria (as it has been shown that such infections lower resistance and predispose to the more severe acute infections of large camps). The following memorandum, prepared April 18th, gives in outline the method of work in the Detention Camp:

"Base Hospital, Camp Zachary Taylor, Ky.,
April 18, 1918.

ORGANIZATION OF DETENTION CAMP

Methods of Handling Draft Quotas

1. *Arrival of New Quotas of Drafted Men.*—Leader of quota will turn over to Company Commander required mobilization papers. Company Commander will prepare the identification card, lists of members of quota, service record, finger print card, 88 M. D., and other forms for physical examination.
2. *Physical examination* shall include:
   (*a*) General physical examination.
   (*b*) Typhoid and smallpox vaccination.
   (*c*) Listing and segregation into two large groups:
      Measles immunes.
      Measles non-immunes.
   (*d*) Swabbing of throats for streptococcus carriers and segregation, as soon as reports are received, into groups:
      Carrier.
      Non-carrier.
   (*e*) Prophylactic streptococcus vaccination.

Note.—These last two provisions could not be carried out for various reasons chiefly because the arrangement of the camp schedules, training, and detention could not be accommodated to them, nor was vaccination against streptococcus on a sufficiently sound basis to permit of its general use.

   (*f*) Examination for hookworm and malaria and proper treatment of infected individuals.
3. *Administration of Detention Camp:*
   A. Absolute quarantine for three weeks.

B. High barb-wire fence around camp, with entrance and exit guards, day and night.

C. Absolute prevention of communication with civilian population, extra cantonment zones, and other portions of the camp.

D. Absolute prevention of mingling in Y. M. C. A., K. of C., Post Exchange, and latrines.

E. Daily instruction in personal hygiene and spread of contagious diseases—Warn the men about lying on each others' beds or pillows, using towels, pipes, or other articles in common. To wash their hands frequently so as not to convey any infection thereon to their air-passages; no common drinking-cups; boiling water for mess kits.

F. Daily program for men to include:

(*a*) Progressively increasing drill and hike schedules—starting very gradually, and adapted to the requirements of the *weakest* man in the outfit.

(*b*) *Twice daily*, inspections for early recognition and segregation of respiratory and contagious disease.

(*c*) Daily weighing of entire command, with inquiry into unusual loss or gain in weight."

Hospital.—Probably the two most important contributions which have been made relative to the control of these infections in the hospital are, first, the masking method, and second, the separation of incoming cases into streptococcus carrier and non-carrier cases. The use of the mask has already been described. The separation of incoming cases into carrier and non-carrier wards has been shown by Levy and Alexander at this hospital to be of distinct value. They noted that the complications in measles occurred almost exclusively in the streptococcus carriers, the incidence in this group being 36.8 per cent., as contrasted with 6.4 per cent. in the non-carrier cases. During the past two months similar separation has been made not only of all measles cases coming into the hospital, but likewise of all general medical cases, including the respiratory group of diseases. These later

studies were made at a time when the incidence of respiratory and streptococcus disease was at its lowest point, and they show a very marked reduction in streptococcus carriers, as compared with carriers in epidemic conditions. For example, of 228 cases of measles coming into the hospital in July, 34.1 per cent. were found to be carriers (Chart VIII), as contrasted with 77.1 per cent. during the month of March (Chart VII) (Levy and Alexander). Pneumonia developed four times, or 1.8 per cent., as against 12.1 per cent. in the early series, three of these, or 2 per cent., developing on the non-carrier wards and one case, 1.2 per cent., developing on the carrier wards; these figures contrast with 6.4 and 36.8 per cent. respectively in the former series.

These figures are particularly interesting, showing that not only is the percentage of carriers markedly reduced (77.1 to 34.1 per cent.) during non-epidemic periods, but apparently the virulence of the organisms themselves must be reduced as evidenced in the complications (12.1 to 1.8 per cent.). We find the same to be true in the general medical cases. Of 390 cases admitted during July, 140 were carriers and 250 were non-carriers; of the former, only one complication developed (0.7 of 1 per cent.). In the latter two lobar pneumonias (0.8 of 1 per cent.). Undoubtedly such percentages would be different in times of epidemics, and it is proposed during the coming winter to inaugurate the same method of segregation at least among the respiratory cases. One word of caution is necessary in determining the value of this method, that is, to determine the type organism responsible for the complication (pneumonitis, pleuritis, etc.), as the finding of streptococcus carriers in measles or general medical cases is not of itself sufficient to stamp the carriers of these cases as being streptococcal in origin. It is only necessary to point out that of the five pneumonias developing during July in the carrier wards, in which bacteriologic studies were made, in none of them could streptococcus be definitely determined, most of these cases being pneumonia, Type II.

Former publications from this camp by the writers and

Alexander and Levy would seem to imply that streptococcus infections are more likely to occur where there are streptococcus carriers. We would prefer to state now that it seems as if the streptococcus carrier state merely indicates in the winter months a probability that complications of some sort may arise.

VIII. SUMMARY AND CONCLUSIONS

A review of the foregoing pages emphasizes the premises with which we started out, that we have experienced a group of epidemics composed of three variables which arose with the advent of draft men and waxed and waned through the first year of Camp Taylor. Generally speaking, two of the variables—pneumococcus infection and measles—presented, when considered by themselves, little or no variation from the former pictures of these diseases, but both were greatly influenced by the presence of a streptococcus infection which started early, assumed many forms, and acted as a superimposed infection upon the first two mentioned. The course of the three variables, as indicated by the charts, is not the same. The incidence of the pneumonias and measles was very much greater during the early period, whereas measles, pneumonia, and streptococcus infections were the dominant features of the late period.

The outstanding clinical phases and pathologic processes of the epidemic are, first, pneumonitis, and second, pleuritis. The pneumonitis produced by the pneumococcus was of the ordinary picture and that of the early cases of measles pneumonia was similar to inflammations of the lung seen in measles before the war. When, however, the influence of the streptococcus was felt, the measles pneumonia assumed peribronchial and diffuse hemorrhagic forms which led to pleuritis. It would seem also that the streptococcus attained some form of virulence or adaptability that permitted a rapid spread of the organisms to the serous surfaces, because in the spring there were cases of primary polyserositis without the pneumonias aforementioned. Not only did the streptococcus have the power of complicating these measles, but it sometimes acted as a member of a mixed infection with a pneumococcus. The effect of the streptococcus

was not only felt in measles, pneumonitis, and pleuritis, but there were also many infections of the ear and sinuses of the head, cases of erysipelas, cellulitis, and other comparable manifestations. A study of these other effects of streptococcus has helped to elucidate the origin and course of the epidemic.

The high point of morbidity appeared in the early spring, after which all the variables declined rapidly due to improved hygienic conditions and weather, and possibly to reduction of virulence; it was probably not due to lack of available material because new men were coming in all the time. There is, however, in reviewing the charts a rough relationship between the advent of draft men and the rise of case incidence due to the three variables.

The origin of the epidemic can be explained on the basis of the collection of a large number of non-immunes because the percentage of arrivals from the rural districts is largely in excess of that from urban. The inception of the epidemics seems to have taken place in the Depot Brigade, the gateway of entry to the camp, where non-immunes under strange and trying circumstances are first exposed to the contagion. Naturally, the attack upon this series of infections began in this area and took the form, first, of attention to personal hygiene; second, to barracks hygiene; third, to regimental hygiene, and fourth, to the daily medical inspection of all possible contacts. The attack upon an infection in the hospital took the form of separating suspected infectious cases from general medical and other cases, both in the receiving ward and within the wards themselves, by the use of cubicles and masks.

We believe that the advent of new infections to the camp can only be controlled by an adequate detention system and sick inspection; that is, seeing every man of the command every day in order to determine whether he is in the incubation period of a disease, since we know that for various reasons sick men are not detected soon enough to give them adequate care or to protect their fellows. It would be well if all immunes and non-immunes could be segregated and if all individuals could be inoculated against streptococcus and pneumococcus diseases. A

very important factor is the arrangement of training schedules so that new arrivals at the camp can become accustomed to their surroundings and training gradually. This is particularly true in winter time when the human body is taxed to its limit to accommodate itself to weather conditions.

We wish to call particular attention to a few facts of clinico-pathologic value. It has been said that there is no hard-and-fast rule upon which to make a decision to operate in cases of empyema. At this hospital we have found that the best time to operate is when the fluid has become creamy, the temperature, pulse, and respiration falling, and when, after a steady rise in leukocytes, there is a tendency to fall.

We wish also to record 3 cases of multiple pneumococcus determination in the sputum: two of these examinations were made by a man of unquestioned ability, the third by a reliable enlisted man.

In the presence of a measles epidemic, particularly when complications are numerous, it would seem well to make cultures from the nasopharynx for the presence of hemolytic streptococcus because there is a very definite relation between the percentage of streptococcus carriers and complications. These need not be streptococcus complications. By this means one can segregate the carrier and non-carrier cases, a measure that seems to have prevented cross infections.

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THE PATHOLOGY OF THE STREPTOCOCCAL PNEUMONIAS OF THE ARMY CAMPS

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During the winter and spring months of 1917–18 there occurred a wide-spread epidemic of a fatal form of pneumonia, especially in the army camps, although affecting also the civilian population in many places.

Study of this disease as reported from a large number of these camps has led to a fairly unanimous opinion that it is commonly although not invariably a sequel of measles, that it is not lobar pneumonia due to an infection with the pneumococcus, but rather a form of bronchopneumonia caused by a streptococcus, and that it is accompanied in an extraordinarily large proportion of the cases by pleurisy, with abundant effusion or empyema.

The present writer had the opportunity of studying many of these cases while serving on commissions sent out by the Surgeon General of the Army to Fort Sam Houston in Texas and to Camp Dodge in Iowa. The details of these studies have been published elsewhere and have shown that the pneumonia is not all of one type, but that in any series of cases a considerable number are caused by the pneumococcus and are really cases of typical lobar pneumonia. The number of cases of this sort is dependent to a great extent upon the season and character of the weather, and is, indeed, not appreciably different from what might be expected in the absence of the main epidemic.

But the predominant affection which brought the figures by which the incidence of the respiratory disease in the camps is recorded up to the proportions of a true epidemic is a quite

different thing, and has been in our experience shown to be caused by a hemolytic streptococcus.

This disease has been especially prevalent in the camps situated in the southern states and has raged particularly severely among recruits from the very isolated rural population of those states. So true is this statement that if the camps are plotted on a map according to the source from which they drew their recruits, as was done in the office of the Surgeon General, all of those most severely affected are found to lie in the South.

In the same way the extensive epidemic occurrence of measles is in the South among the same troops. Thousands of cases of measles have occurred, and the epidemic pneumonia of which we speak presents itself as a definite sequel of measles.

It is true that it may follow other diseases, such as scarlet fever or German measles, but the importance of true measles in this regard is paramount. It is also true that having once established its virulence and ready infectivity, the streptococcus may proceed to infect great numbers of men independently, and at Camp Dodge we were impressed with the fact that there had been very little measles, and that very well isolated, so that the great epidemic began in the camp apparently without dependence upon that disease. When it did occur in the measles barracks at the end of the epidemic it was far more rapidly fatal there.

Anatomically the pneumonia caused by the hemolytic streptococcus takes two forms—either it is essentially a bronchopneumonia in which extensive processes of organization and induration are rapidly developed—a form which we call interstitial bronchopneumonia, or it is a lobular exudative inflammation in which no such evidences of any powers of resistance are to be found. In both cases it is accompanied by empyema and by a few other changes especially in the upper respiratory tract.

In the history of medicine there are recorded numerous epidemics of pneumonia, beginning with the early part of the sixteenth century. They spread over Italy, Spain, France, Germany, and other countries, always involving great num-

bers of people with a very high mortality among those affected. It is difficult to recognize with certainty the types of pneumonia in these early epidemics, but the descriptions are so emphatic as to the frequent existence of empyema that it suggests the streptococcal rather than the pneumococcal form of infection.

In America similar outbreaks are recorded from the eighteenth century, and during the war of 1812 there was a great epidemic which spread among the troops in northern New York, and later among civilians not only in New York and the New England States, but throughout all the southern states. It lasted until 1815 in the North and dragged on until 1826 in the South. The descriptions of clinical symptoms and of some postmortem examinations lead one to believe that this was an affection quite like that which we have encountered during the past winter, even though some of the cases have greater resemblance to lobar pneumonia.

In the war of the rebellion, as recorded by Woodward and others, measles was extremely prevalent and was commonly followed by a form of pulmonary affection which was often described as bronchopneumonia and as associated with empyema. There were more than 61,000 cases of pneumonia during the four years of the war, and of these a large number was separated as related in some way to measles. More than a hundred postmortem examinations are recorded, and one surgeon had the happy idea of preserving three specimens of lungs from these cases in the Army Medical Museum in Washington. The authorities there kindly gave me permission to study these specimens which had stood in alcohol for fifty-four years. They showed plainly the gross appearances which had become familiar in the study of the streptococcal bronchopneumonia of today, and in microscopic section still stained pretty well and presented lesions identical with those of the cases in the epidemic of last winter. Bacteria stained in these sections as brightly as in any modern tissue, and one could recognize streptococci in typical chains in the bronchi and pleural exudate.

In reviewing the cases met with in the army camps already

mentioned it was found that they fell into several classes. There were two predominant organisms concerned—the pneumococcus in its various types and the hemolytic streptococcus. Corresponding with these etiologic agents, there were pure cases of lobar pneumonia, on the one hand, and on the other far more numerous cases of interstitial bronchopneumonia and lobular pneumonia. In addition, there were combinations of these lesions, and it was not uncommon to find that the streptococcus had invaded the lung of a person who had a well-developed pneumococcal lobar pneumonia and had overgrown and supplanted the pneumococcus, or even that lobar pneumonia with living pneumococci and bronchopneumonia with abundant streptococci might occur side by side in the same lung.

It is not necessary to discuss here the cases of lobar pneumonia following infection with the pneumococcus, since these showed no especial peculiarity. They will, therefore, be mentioned only in so far as they occurred in combination with the streptococcal infections.

The streptococcal forms of pneumonia are spoken of definitely as such because of the fact that in every case which we studied the Streptococcus hemolyticus was isolated from the sputum, and pleural exudate before death and from the heart's blood, lungs, pleural fluids, pericardial exudate, and various other lesions after death. Ordinarily they were in pure culture, although in a great many cases the influenza bacillus was found in the sputum, and occasionally even in the lung and pleural exudate. This is one fact which may throw doubt upon the actual significance of the streptococcus in the minds of some, especially since several English writers have recently reported in France and England epidemics of a similar bronchopneumonia without much pleurisy, in which they obtained the influenza bacillus in pure culture from the sputum and occasionally from the smaller bronchi. Others in this country have found a non-hemolytic form of streptococcus. The fact that we have found the influenza bacillus in the tissues in only two cases and a definitely hemolytic streptococcus in every one, demonstrable in great numbers in immediate relation to the

lesions in microscopic sections, makes us believe that, after all, it is the really important element in the causation of the disease.

Little need be said in a paper on the pathology of the streptococcal pneumonia of the clinical signs and symptoms. The patients usually start a few days after the onset of measles, or a few days after convalesence from that disease, with a pain in the chest, sore throat, cough, a chill, high fever, and general malaise. The physical signs are indefinite, but there is usually some vague dulness over the chest and râles are heard scattered widely throughout both lungs, especially at the bases and behind. The patient becomes dyspneic, the respiration being especially labored in inspiration, cyanosis of a curious livid type appears, and there is a great deal of nervous excitability and apprehension. The dyspnea produces extreme discomfort and the most violent inspiratory efforts are made, bringing into play all the accessory muscles; this makes sleep impossible. The eyes are bright and shining, the mind most alert and filled with dread.

After a few days' dulness or flatness over the thorax becomes apparent and an exploratory aspiration reveals the presence of turbid fluid in the pleural cavity. The accumulation of this takes place with extreme rapidity, and it is replaced when removed in a surprisingly short time.

Delirium is not uncommon, and death often occurs after ten days or two weeks of such illness, although in some cases the whole course of the disease from the onset of the bronchial symptoms to death was only four or six days. Hoarseness or complete aphonia is especially characteristic of the cases which develop most rapidly and intensely after measles, but it sometimes occurs in those who have not had that disease.

At autopsy in the cases in which death has occurred a few days after the onset of the disease the pleural cavities are often found to contain no excess of fluid and their surfaces are smooth and glistening. In the great majority of the cases, however, there is present a considerable amount of exudate in at least one pleural cavity, sometimes in both. The pleural surfaces

are sprinkled with small petechial hemorrhages, especially over the back of the lung, and covered with a thin rough exudate of fibrin. In such instances the fluid is thin and watery, turbid and brown or greenish brown, with a granular sediment easily stirred up from the bottom and many floating shreds or flakes of fibrin. It is swarming with the streptococci in chains usually unmixed with any other organism. In cases which have run a longer course the fibrin on the surface is thick, yellow, and shaggy. There are often to be found adhesions between the lobes, between the lung and the costal pleura or diaphragm, or in such an arrangement as to separately enclose a space between the mesial surface of the lung, the pericardium, and the diaphragm. There the fluid exudate is distinctly purulent in character and either opaque greenish yellow or brownish gray with a slight blood-staining. The disposition of the adhesions often allows of the encapsulation of pockets of this pus between the lobes or elsewhere, especially often in the situation above described between the lung and the pericardium. Incision into the surface of the lung shows that the pleura itself has become greatly thickened by being converted into a layer of granulation tissue which tends to organize and replace the fibrinous exudate. The rapidity with which this organization occurs is surprising. When the pleura has been evacuated by operation the character of the exudate and the thick layer of granulation tissue upon the surface is unchanged, unless secondary infection has occurred, when the pus may become exceedingly foul.

The effect of this great accumulation of exudate in the pleura, which may amount to one or two liters or more, is to cause the extensive collapse of the lung, which appears as a blue pasty mass of tissue plastered against the mediastinal tissue. This is not the only cause of collapse, however, since obstruction of the bronchi plays a part, and it frequently appears in parts of the opposite lung even when there is no exudate in that pleural cavity.

The lung is, in general, flabby, but there may be felt throughout its substance nodules or larger areas of consolidation. The bronchi exude a thick brownish purulent exudate, and the

bronchial glands are enlarged and soft. On section the lung itself presents in different cases a very great variety of appearances. Those which form the anatomic complex of interstitial bronchopneumonia may be described first and afterward those of which we have spoken as lobular pneumonia, although it must be remembered that they are very frequently combined.

In the early stages of interstitial bronchopneumonia there is already a patchy atelectasis of the lung, the bronchi are filled even to their smallest branches with opaque yellow pus and are surrounded by a halo of hemorrhage. Otherwise the lung substance is air-containing in part and in part edematous. In all cases the hyperemia of the tissue is very striking. In such early cases microscopic examination shows the bronchioles filled with polymorphonuclear leukocytes and streptococci often in tangled masses ranged along the wall. The lymphoid tissue in the bronchial wall is slightly swollen through an increase in the number of its lymphoid cells. The adjacent alveoli are filled with blood and contain a few leukocytes.

Somewhat older cases show on section numerous firm projecting nodules throughout the lung, which on close inspection are found to be cross-sections of bronchioles with surrounding consolidation. If the bronchioles happen to be cut longitudinally, these condensations of the tissue appear not as nodules, but as very thick-walled tubes further surrounded by a mantle of consolidated lung tissue. The area to which such a bronchus, obstructed as it is with a mass of purulent exudate, should supply air is collapsed completely. The consolidation is scarcely in this area, but rather in the alveoli adjacent to the bronchus. These too may sometimes be surrounded by hemorrhage, but usually that is only in the freshest cases. Viewed on cross-section the tiny bronchiole with its thickened wall and surrounding area of consolidation projects like a tubercle from the cut surface. Indeed, it is probable that when these are fairly small and uniform they have often been mistaken for miliary tubercles. As they increase in size they become more and more nearly confluent, and the intervening tissue shows a viscid edema which drives out its original content of air. In

time quite extensive areas show a patchy irregular consolidation through the coalescence of such peribronchial areas.

Microscopically the bronchial wall is still found to be the part most intensely affected, the streptococci are present in the purulent exudate in about the same numbers; much of the epithelium is found to be desquamated, and in some cases of most intense infection the whole lining of the bronchus is necrotic and coagulated, and appears as a diphtheritic pseudomembrane. The wall of the bronchus is greatly thickened and densely infiltrated with mononuclear cells of the type of lymphoid cells, with some larger forms. It is probable that much of this represents a hyperplasia of the lymphoid tissue normally found scattered in the wall and condensed at the angles of division. This is especially indicated by the peculiar course of the blood-vessels in this cellular tissue, which is that of the blood-vessels of the lymph-nodes. But much of the thickening of the wall is due to actual new formation of connective-tissue cells, to edema and hyperemia, and to a true infiltration of wandering mononuclear cells. It assumes the appearance in many cases of a richly vascular granulation tissue in which the new blood-vessels are radially arranged, and in which, in the case of larger branches, remnants of mucous glands are to be found. The infiltration with mononuclear cells extends to the walls of the adjacent alveoli, which are thereby much thickened. These alveoli contain a dense exudate which is no longer composed of blood, but of desquamated epithelial cells, mononuclear cells, and solid plugs of fibrin. Further out the fibrin is replaced by fluid which appears to be especially thick and viscid. No streptococci are to be found in the substance of the bronchial wall or alveolar walls, nor even in the exudate in the alveoli. They are present, however, in abundance in the lymphatic canals which run in the bronchial walls, and there they are entangled in a thrombus mass which includes also many mononuclear cells. Such lymphatics extend in this thrombosed condition throughout the lung and communicate, on the one hand, with the sinuses of the lymph-nodes at the hilum of the lung, on the other with the network of lymphatics in the pleura. It

is thought that it is through them that infection extends from the bronchi to the pleura. This is against the natural current of the lymph, but the organisms extend by growth along the obstructed lymphatic canals.

The blood-vessels are not thrombosed nor otherwise altered except that their adventitial tissue is densely infiltrated with cells. This, again, may be partly due to hyperplasia of the normal lymphoid tissue, especially since such infiltration after extending outward from the bronchial walls fades away in the alveolar walls until one approaches blood-vessels or interlobular septa when it increases again.

The interlobular septa are greatly widened and most conspicuous on the cut surface of the lung. This is due, first, to their infiltration with fluid cells and fibrin, which later becomes replaced by connective tissue, and second, to the presence in their course of lymphatic canals which are thrombosed and distended with opaque yellowish white material. Such thrombosed lymphatics stand out on the cut surface of the lung running to the pleural network as huge opaque beaded strands sometimes large enough to be mistaken for bronchi.

Finally, the organization of the exudate in the alveoli and in the bronchi and its replacement by strands and columns of connective tissue ultimately clothed in alveolar epithelium forms a striking feature of the late stages of this process. The thrombosed lymphatics are similarly converted into solid vascularized cords of fibrous tissue, which must indicate the need for a most extensive new formation of lymphatics if absorption from the pleura is to be resumed. Then, as described above, the pleura itself becomes a thick red velvety layer of granulation tissue through the organization of the overlying fibrin.

The restricted distribution of the streptococci is most interesting. They are found in the bronchi, in the lymphatics, and in the pleural exudate, where they are limited pretty sharply to the surface layer of the fibrin and the fluid. The whole process indicates their inability to invade the tissue proper, and shows that the body is offering a strong resistance and erecting massive barricades against their entrance.

All this is quite different in the second form of the pneumonic process, which we have designated "lobular pneumonia." In these lungs there are found patches of consolidation associated with wide zones of hemorrhage, but in no such regular relation to the bronchioles as has just been described. These patches may be terminal, occupying the area supplied by a bronchiole, or they may be confluent and large enough to occupy one or several lobules; sometimes they have the granular appearance of the cut surface of a lobular pneumonia, but more often they are elevated, dry, dull and opaque, and thickly surrounded by dense hemorrhage. There is no especial thickening or prominence of the bronchi. The interlobular septa are not necessarily prominent and often the pleura is but little thickened. The lymph-channels are, however, thrombosed and very large and conspicuous in many cases. Microscopically it is found that there is no remarkable change in the bronchi except that they are full of purulent exudate and blood, but all the alveoli in the area are packed tightly with leukocytes in a network of fibrin, and among these leukocytes and often enclosed within them there are great quantities of streptococci uniformly scattered throughout the alveolar contents, a condition totally at variance with that found in the interstitial bronchopneumonia. The alveolar capillaries are sometimes occluded by hyaline fibrinous thrombi. Whole areas of such consolidated and intensely infected lung become necrotic, and it is especially about such patches that extensive hemorrhage occurs. In these necrotic patches the streptococci grow out into long chains which form a dense tangle.

It must be said that small areas of such exudation into the alveoli with abundant streptococci are quite often found in the most intense and acutely developed lesions of interstitial bronchopneumonia constituting a combination of the two lesions. The explanation of the existence of two such distinct types of reaction to the invasion of the streptococcus is not entirely easy. It seems very similar to the condition in tuberculous infection of the lung. In one case we may have a few tubercle bacilli setting up the formation of tubercles, tuber-

culous invasion of the lymph-channels, interstitial induration, etc., while in another case, or later or earlier in the same case, there is a sudden exudation into a whole area of pulmonary tissue, and the production of a gelatinous and caseous tuberculous pneumonia with great numbers of bacilli and rapid destruction of the tissue. It must be due to a remarkable difference in the power of resistance to invasion on the part of the tissues. Kraus has written lately suggesting the probability that this sudden invasion of the tissue by bacteria which were formerly held within bounds is due to a sensitization of the tissue by the previous infection. Possibly the same explanation might hold in this case, although the whole process occupies a very short time. At any rate, that seems to be another way of expressing the idea that resistance in one case is strong, in the other almost absent.

In the cases of lobular pneumonia great areas of necrotic tissue often become coagulated, opaque, and yellow, and appear as abscesses which may occupy a large part of a lobe. This is not limited to the obvious cases of lobular pneumonia, but sometimes occurs in those in which interstitial changes are prominent. The liquefaction of this material and its discharge through a bronchus leaves a ragged cavity which may in some instances through forming a communication with the pleura set up a fistulous connection between the pleura and a bronchus.

Of complications in other parts of the body there is relatively little to be said. The upper respiratory tract through which the infection occurs is everywhere infected. The pharynx is usually reddened, the tonsils not enlarged, but containing in their crypts abundant streptococci. The uvula, pillars of the fauces, pyriform sinuses, and edges of the epiglottis, as well as the aryteno-epiglottic folds, and *par excellence* the vocal cords are subject to streptococcal invasion and ulceration. Edema and a phlegmonous inflammation of these regions with myriads of streptococci in the tissues are observed. The vocal cords are often quite deeply ulcerated throughout their whole length with streptococci in great numbers strewn in the base of the ulcers. This is the reason for the hoarseness or complete loss

of voice which was mentioned. The trachea is reddened, but not ulcerated. The cervical lymph-nodes along the trachea are enlarged. Otitis media occurs sometimes through extension along the eustachian tube.

Pericarditis with effusion of purulent fluid and fibrinous exudate replaced later by adhesions is not very uncommon, and in some cases leads to enormous distention of the pericardial sac. Peritonitis was observed several times and appears to be due to extension of the infection through the diaphragm by way of the thrombosed lymphatics.

There were no especial changes in the abdominal organs which could be definitely associated with this disease. The testicles showed a cessation of spermatogenesis, the tubular epithelium being reduced to a single layer of spermatogonia and Sertoli cells.

Abscesses in the body musculature are sometimes seen, and I have heard of infections of the joints, although none occurred among the cases studied. Hyaline degeneration of the muscle-fibers of the rectus abdominis is rather common, as in typhoid fever, and sometimes leads to symmetric rupture of those muscles, with the formation of hematomata. There has been much discussion as to the existence of a definite septicemia in these cases, and we can only say that blood-cultures have been negative except when taken a short time before death. A few organisms may enter the circulating blood, but there seems to be no typical septicemia.

Combinations of streptococcal interstitial bronchopneumonia with lobar pneumonia have been mentioned, and in these cases the two lesions remain fairly separate and overlap but little.

To summarize, it may be said that an extensive epidemic of pulmonary disease has resulted from wide-spread infection with a hemolytic streptococcus which invades most readily upon the basis of a predisposing attack of measles.

This produces inflammatory and ulcerative changes in pharynx and larynx and, extending to the bronchioles, sets up a bronchopneumonia which may in persons of poor resistance

take the form of a lobular pneumonia with extensive spread of the organisms and rapid necrosis, or in those with better powers of resistance produce a purulent bronchitis with great thickening of the bronchial walls and consolidation of the adjacent pulmonary tissue, infection of the lymphatics, and thence of the pleura. Induration of the framework of the lung and organization of the exudate tend to limit the process. In both types pleurisy with abundant effusion is very common.

FUNCTION OF A BASE HOSPITAL IN A NATIONAL ARMY CANTONMENT

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In order to appreciate just what part a base hospital plays in the medical work of a large army cantonment one must have a mental picture of the problems presented to the medical corps in one of these camps. The base hospital in a cantonment is a part of the command under the general in charge and, therefore, intimately connected with all the camp problems. One should also bear in mind that the name of base hospital applies to other hospitals of the medical department than those situated in a cantonment. The problems presented to these other base hospitals may be quite different from those met in a cantonment.

The problems presented to the medical department of the army in a cantonment may be grouped as follows:

The physical examination of officers, nurses, soldiers, and drafted men.

The care of the sick and wounded.

The prevention of disease.

The advance of medical knowledge and science.

The articulation of the camp medical work with the Surgeon General's office.

As the organization of the medical work in the various cantonments has, in a certain measure, been left to the local authorities in the cantonments, there is naturally some variation in the work assigned to the hospital in the various camps, but it is surprising to see how similar the work is in all the essential features. Although the primary function of the base hospital is the care of the sick and wounded, many of the other medical problems of the camp are carried out, in part at least, by the base hospital.

The base hospital staff must be prepared to make the routine physical examination of officers and nurses, as all reporting to the hospital for their first station must have a physical examination. Furthermore, for various other reasons, such as promotion or discharge, the routine physical examination has to be completed by the base hospital officers. Although the routine examination of the recruits is carried out under the supervision of the camp surgeon by medical officers not attached to the base hospital, there are certain special cases which are referred to the hospital staff. These are the cases which require special apparatus for investigation, or the advice of a specialist, such as the otologist, roentgenologist, or opthalmologist. It becomes, therefore, the function of the base hospital during the examination of a fresh increment from the draft to be prepared to help out the examining board on these special cases.

Intimately associated with the physical examination of soldiers is the determination by medical officers of a soldier's physical fitness for duty following some injury, or illness, or the wear and tear of active service. It has been found convenient in many camps to have the medical officers for this board chosen from those on the staff of the base hospital and to have the meetings of the board held at the base hospital.

The base hospital must be ready to take care of any or all of the sick or injured from the camp. As it is the custom to send to the hospital all cases of acute infection from a common cold to the most serious cases, it may receive without any warning a large number of patients for admission. It is conceivable that during an epidemic the base hospital will be unable to handle all the cases sent to it, but it must be prepared to expand as much as possible if the camp surgeon decides it is advisable to crowd cases into the hospital rather than to treat them elsewhere. The cases for the hospital are picked out by the regimental surgeons at what is known as "sick call." No attempt for careful differential diagnosis is made at sick call, as all the opportunity offered the regimental surgeon at that time is a chance to pick out the cases which should be sent to the hospital.

The hospital, therefore, must be prepared, in receiving the

patients, to send them to the appropriate services which will be specially prepared to care for the various diseases. The receiving officer must also be prepared to separate the contagious cases if any such should appear. For the care of this great variety of disease the government has provided an excellent equipment, especially for the study and treatment of acute disease. In addition to providing a good equipment, the government also has arranged that the staffs of these hospitals will be well supplied by specialists. It is, therefore, the duty of the base hospital in a cantonment to employ every aid in diagnosis and treatment of disease that can be employed by the ordinary clinician or the specialist.

The base hospital in these camps must also be prepared to follow up the convalescence of a patient for a longer period than is customary in civilian hospitals, because from the hospital the soldiers are sent to duty and must be ready soon to undertake hard work. In order to care for them in this period the hospital has a special group of convalescent patients who have graded exercises and instruction. Eventually many of these hospitals will have some sort of occupational therapy to help fill up the time of these soldiers.

At the base hospital is situated the morgue, which is under the immediate direction of the chief of the laboratory service. This morgue cares for the bodies of those who die in the camp or surroundings, as well as those who die in the hospital. The handling of the bodies of a large number of deceased soldiers at one time becomes a problem of considerable magnitude and importance for the base hospital.

The impression perhaps created that all sick and convalescent soldiers are treated in the base hospital in a cantonment is not entirely correct, for a certain number of venereal cases are handled in the infirmaries of the various organizations. Also in the Depot Brigade of the camp there are grouped certain soldiers in what is known as the Development Battalion, and certain of the convalescent patients may be referred to that group.

Even in a cantonment the problem of transportation of the

sick and wounded, which is such an important factor in the field, requires considerable attention. It may fall entirely to the hospital to maintain the ambulance service for the camp, or this work may be carried out by the ambulance companies situated elsewhere in the camp. In the latter case the hospital will probably be called upon to maintain an ambulance service for some part of the twenty-four hours at least.

To insure the army against disease as much as possible the medical department endeavors to keep the causes of disease away from the soldiers and to increase their resistance against certain diseases by vaccination. To keep disease away from the soldiers rules in regard to hygiene, sanitation, and isolation are established by the Surgeon General's office and modified by the Camp Surgeon to suit the local conditions. The base hospital's function in regard to hygiene and sanitation is simply to see that the rules of hygiene and sanitation are enforced in the hospital and its surroundings, and among the enlisted men, nurses, and officers of the command. In regard to isolation of carriers of disease germs the hospital plays a more important part, for it is in the laboratory of the base hospital that the cultures are taken to determine the presence of carriers. When a case of diphtheria or meningitis, for example, occurs in a barracks all the men in immediate contact with that soldier are sent to the laboratory and cultures from their noses and throats taken. All the carriers found among these men are isolated at the base hospital.

The vaccinations against disease are made in the infirmaries of the organizations to which the soldiers belong at entrance, but the base hospital must be prepared to carry on these inoculations on its own command and, in cases of emergency, for soldiers of other organizations. Two other important customs in the army to prevent the spread of disease are the physical examination of soldiers twice a month to the extent of inspection of mouths, skin, and genitalia, and the prophylactic treatment after exposure to venereal disease. The base hospital, of course, carries out these customs in regard to its own detachment of soldiers.

The base hospital has an excellent chance to advance medical science by the opportunities offered for investigation. The opportunity for autopsies in the army is greater than in civil life, so there is plenty of pathologic material for study and, therefore, the chance to thoroughly complete the observations on a given problem is not blocked as it so often is in civilian hospitals. The government, by its policy of well equipping the laboratory, offers a splendid opportunity for special investigations and research in the laboratories at these base hospitals. The opportunity to make a careful clinical study of cases is excellent in the army, as the patient is always under control, and cannot slip away from observation before the case is completely studied or the desired treatment properly carried out. A base hospital in a cantonment is not doing its duty unless it adds something of value to the medical literature.

In addition to producing original medical work, the base hospital should act as a graduate school of medicine for medical officers who have not had the opportunity to keep abreast of the advances in modern medicine. For this purpose the base hospital should arrange for clinics and courses of instruction for its officers and other medical officers in the camp.

The establishment of a branch of the Army Nurses' Training School in most of the cantonment base hospitals shows the demand upon these hospitals to do their share toward the development of trained female nurses. In addition to the training of female nurses, the base hospital must develop the men of its own detachment to perform the various duties assigned to them. The development of good ward masters is especially important.

Should any part of the medical department become detached or isolated from the whole structure, its efficiency would be seriously impaired. The connecting link between all the different units of the medical department is the Surgeon General's office, and the so-called "paper work" of the army is the medium of communication between the various units and the Surgeon General's office and each other. In order to articulate smoothly with the Surgeon General's office the base hospital

must see that its reports and records are sent in accurately and on time. The importance of this is further exaggerated when one realizes that from these reports information of inestimable value is furnished in regard to statistical studies upon the prevalence, course, and treatment of disease in the army.

In this hasty sketch of the function of a base hospital in a National Army Cantonment an attempt has been made to give an idea to the civilian physician what type of work a physician is called upon to do who is assigned for duty at one of these hospitals. The point which should be emphasized is that, in addition to the actual diagnosis and treatment of the sick, there are many other duties which must be well carried out in order to make the hospital properly fulfil its function.

RESULTS OF THE EXAMINATION OF 23,943 DRAFTED MEN BY THE CARDIOVASCULAR BOARD AT CAMP JACKSON, COLUMBIA, S. C.

By Major Edward H. Goodman, M. C., U. S. A.

During the months of June and July there have been 48,844 draft men examined at Camp Jackson. For a time the heart and lung examinations were within the province of the tuberculosis board, but recently a cardiovascular board has been created which has relieved the tuberculosis board of the responsibility of the cardiac cases. The system in force at Camp Jackson seems to be admirable in many respects. The recruits are first examined by the pulmonary board, and in this way a common cause for tachycardia is detected, making the interpretation of these difficult cases a somewhat easier matter.

The cardiovascular board consists of five teams, of two men each. These two men are termed "Routine man" and "Reject man," the routine man and the reject man both doing routine examinations, but the reject man alone having the authority to reject cases. He is chosen for this office because of his experience and judgment, and when there is a case which, in the opinion of the routine man, is a borderline case, the recruit is referred to the reject man, whose decision may be final, but who has the privilege of referring these cases to the president of the board, whose decision must be final. All such cases, whether they prove to be definitely normal or abnormal, are taken up on the special government form, on which is a record of the history and physical examination. A clerk who has been carefully instructed in history taking relieves the reject man of much of the paper work, and much time is saved thereby.

All cases rejected or accepted must have a form made out, and since assuming charge of the board I have had duplicate histories written for all accepted cases. The reason for this will be apparent, as, so long as the recruit remains at Camp Jackson, we have a record of his physical examination at the time of his acceptance for military service, to which to refer should the man be referred to the board from sick call, as is often the case. This system has been particularly useful recently during the time men were being examined for overseas duty, as we were able to check up on the cases which had a short time previously passed through our hands.

Since June 22d these duplicate histories have been collected from the accepted referred cases from a grand total of 23,943 men examined since that time:

A. Total number examined	23,943
B. Number referred to reject men	656
C. Total number of B accepted	350
D. Total number of B rejected	306

Percentages

1. Per cent. of B to A	2.3 per cent.
2. Per cent. of C to B	53.3 "
3. Per cent. of D to B	46.6 "
4. Per cent. of C to A	1.4 "
5. Per cent. of D to A	1.2 "

It will be seen from the above figures how efficiently some of the draft boards are co-operating in this work, and it is a record for them to be proud of that only in 2.6 per cent. of all the cases was there any doubt about the physical condition, and that only 1.2 per cent. were found to be unfit for military service.

The table on page 401 shows the diseases encountered, their number, the incidence of the disease or defect in 23,943 men, the number of each disability that was accepted or rejected, and the percentage of acceptance or rejection to the number of cases exhibiting that disease. Our rules for rejection were strictly interpreted, and inasmuch as we were instructed to eliminate the waiver class, our cases resolved themselves into the accepted

TABLE OF 656 REFERRED CASES FROM 23,943 DRAFT MEN

	Number.	Per cent.	Accept.	Per cent.	Reject.	Per cent.
Myocarditis	9	0.036	0	0.00	9	100.0
Mitral stenosis	17	0.071	0	0.00	17	100.0
Mitral insufficiency	69	0.28	10	14.4	59	85.5
Aortic stenosis	9	0.036	1	11.1	8	88.8
Aortic insufficiency	19	0.079	0	0.00	19	100.9
Congenital lesions	2	0.008	1	50.00	1	50.9
Bradycardia	1	0.004	1	100.0	0	00.0
Tachycardia, simple	182	0.76	97	53.3	95	46.6
Sinus arhythmia	4	0.016	4	100.0	0	00.0
Extrasystolic arhythmia	37	0.11	33	89.0	4	10.9
Dilatation	1	0.004	0	0.00	1	100.0
Hypertrophy (without hypertension)	22	0.09	18	81.8	4	18.1
Hypertrophy (with hypertension)	27	0.10	5	18.5	22	81.4
Functional cardiovascular disorder	26	0.10	6	23.0	20	76.9
Pulmonary systolic	42	0.17	42	100.0	0	0.0
Apex systolic	66	0.27	66	100.0	0	0.0
Cardiorespiratory	32	0.13	32	100.0	0	0.0
Murmurs without significance	2	0.008	2	100.0	0	0.0
Hyperthyroidism	48	0.13	18	37.5	30	62.5
Arteriosclerosis	20	0.08	0	0.00	20	100.0
Aneurysm	2	0.008	0	0.00	2	100.0
Femoral	1					
Carotid	1					
Aortic syphillis	2	0.008	0	0.00	2	100.0
Arterial hypertension	3	0.012	0	0.00	3	100.0
Goiter (simple)	2	0.008	2	100.0	0	0.0
Normal heart	10	0.04	10	100.0	0	0.0
Reduplication (first mitral)	1	0.004	1	100.0	0	0.0
Reduplication (second pulmonic)	1	0.004	1	100.0	0	0.0

or rejected groups. The following diseases in our series were, without exception, rejected:

Class A:

1. Aortic insufficiency.
2. Mitral stenosis.
3. Myocarditis.
4. Arteriosclerosis.
5. Cardiac dilatation.
6. Aneurysm.
7. Aortic syphilis.
8. Arterial hypertension.
9. Mitral insufficiency with hypertrophy, tachycardia, hypertension, and poor response to exercise.

The following conditions were, without exception, accepted:

Class B:

1. Sinus arhythmia.
2. Pulmonary systolic murmur.
3. Apex systolic murmur.
4. Cardiorespiratory murmur.
5. Mitral insufficiency without hypertrophy, tachycardia, hypertension, and with good response to exercise.

The following defects were in some instances rejected and in some instances accepted:

Class C:

1. Aortic stenosis.
2. Congenital lesions.
3. Tachycardia.
4. Extrasystolic arhythmias.
5. Hypertrophy without hypertension.
6. Hypertrophy with hypertension.
7. Functional cardiovascular disorder.
8. Hyperthyroidism.
9. Simple goiter.

Thus it will be seen that the average run of cardiovascular cases numbers not more than 25, of which 9 can be absolutely rejected, 5 unconditionally accepted, and but 9 which require any special study before their disposition can be determined. Records have been kept of the cases in Classes B and C, and these will be analyzed in this paper.

I. Analysis of accepted cases—Class B.

1. Sinus arhythmia: Only 4 cases were seen exhibiting this alone. Other cases, it is true, had sinus arhythmia, but they had symptoms or signs of a more prominent condition, under which they have been classified. We were impressed with the relative infrequency of this type of arhythmia, termed by McKenzie "the youthful type." The men were between twenty-two and twenty-three years of age, and apart from syphilis and the history of pneumonia in one man, the previous medical history was negative. Two were without any complaints and two had dyspnea, palpitation, pain, and giddiness. One man

had a blood-pressure of 152–98, while the others were normal. The exercise test was normal in all, but one reacted more slowly than the others, and this one had a cardiorespiratory murmur.

The condition is essentially benign, and although there is s ill some confusion about its recognition, it should never be confounded with the serious arhythmias.

2. Pulmonary systolic murmur, 42 cases: This was a relatively frequent occurrence, the murmur being heard in the second, third, or fourth left interspaces, and sometimes as far as the fifth, but generally loudest in the second and third interspaces. The diseases which might have some etiologic bearing on the production of the murmur occurred as follows:

Syphilis	11	Immoderate smoking	4
Tonsillitis	9		
Pneumonia	8		
Rheumatism	5		

Few of the men were engaged in occupations which demanded heavy work, so this factor can have little to do with the etiology.

Most of the men had symptoms distributed as follows:

Palpitation	28
Giddiness	25
Pain	23
Dyspnea	21
Edema	6
Fainting	5

The blood-pressure was somewhat elevated and also the pulse-rate, but the response to exercise was universally good. The average blood-pressure was 135–86.

Other phenomena associated were—

Apex systolic	1
Slight thyroid tumor and tremor	1
Slight hypertrophy	1
Tachycardia	1
Exophthalmos	1

In only one instance was the murmur better heard in the recumbent position.

Does the frequent occurrence of syphilis have any bearing?

3. Apex systolic murmurs, 66 cases: This murmur, in every sense benign, is of relatively frequent occurrence. The incidence of diseases with some possible bearing was:

Tonsillitis	19		
Pneumonia	12		
Rheumatism	10		
Syphilis	8		
Scarlet fever	2		
Chorea	1	Immoderate smoking	5

The symptoms occurred—

Palpitation	45
Dyspnea	32
Giddiness	28
Pain	25
Edema	5
Fainting	1

The average of pulse-rate was somewhat above normal, but in nearly every case with but very few exceptions the response to exercise was good. The average blood-pressure was 131–85.

Other phenomena associated were—

Pallor	3
P_2 accentuated	3
Tachycardia	4
Systolic thrill	2
Pulmonary systolic	2
Diffuse apex	2
Slight hypertrophy	1
Thryoid tumor and tremor	1

The frequent occurrence of tonsillitis in the previous history raises the question whether some of these apex systolic murmurs are really accidental or are caused by valve lesions. Clinically one cannot say definitely, but our diagnosis has rested on the

quality of the murmur, the sharp localization of the murmur (no transmission), and the disappearance of the murmur when the individual is recumbent. It would be a practical and academic question not without bearing on the future word of the cardiovascular boards if these cases of supposedly benign systolic murmurs could be followed up and examined later to determine their physical condition after several months of army life.

4. Cardiorespiratory murmurs, 32 cases:

Previous medical history:
- Tonsillitis..... 15
- Syphilis..... 5
- Rheumatism..... 4
- Pneumonia..... 3
- Chorea..... 1

Immoderate smokers..... 3

Symptoms:
- Palpitation..... 24
- Dyspnea..... 13
- Giddiness..... 9
- Pain..... 7
- Edema..... 5
- Fainting..... 2

The average pressure was 127–79.

Other phenomena assocated:
- Accentuated aortic second..... 1
- Accentuated pulmonary second..... 1
- Cyanosis—exophthalmos..... 1

The cardiorespiratory murmurs were all systolic in time and were heard for the most part at the apex, though not infrequently at the angle of the left scapula. They are best heard during deep inspiration and expiration—being loudest in the middle of both and disappearing at the end of full inspiration and complete expiration. The only confusion that can possibly arise is the differentiation between it and cog-wheel breathing, but the latter can be eliminated by having the man hold his breath in mid inspiration, when the murmur will persist.

Tonsillitis here, as well as in the apex systolic murmurs, was encountered rather frequently.

5. Mitral insufficiency without hypertrophy, tachycardia,

hypertension, and with good response to exercise: Ten such cases occurred out of 69 cases of mitral insufficiency. In some no etiologic factor could be determined.

Previous medical history:
- Tonsillitis..... 4
- Rheumatism..... 3
- Chorea..... 1
- Pneumonia..... 1
- Syphilis..... 1

Immoderate smokers..... 2

Symptoms:
- Dyspnea..... 8
- Palpitation..... 6
- Giddiness..... 6
- Pain..... 3
- Fainting..... 3

None of these cases had hypertrophy, 4 had pressures above 135 mm. Hg., and 2 had poor response to exercise. However, the 4 causes for rejection—namely, hypertrophy, tachycardia, poor response to exercise, and hypertension—were not present in any one individual. The striking thing in these accepted cases was the absence of hypertrophy and the good response to exercise which distinguishes them from the rejected cases.

The blood-pressure average was 128–80.

Other phenomena:
- Pulmonary systolic..... 2

II. Analysis of cases—Class C.

1. Aortic stenosis: This disease is generally to be rejected, but in one instance we took the risk of accepting the man, as he was a good physical specimen, had no complaints, and had a good response to exercise.

2. Congenital lesions: When definitely proved, as far as clinical examinations can go, the condition is a cause for rejection according to the manual of instructions for medical advisory boards. The case we accepted was diagnosed by us as patent ductus arteriosus Botalli, and showed absolutely no discomfort from his defect. He had always been active, and examination,

as far as hypertrophy, pulse-rate, and exercise response, was negative. Adult cases of patent ductus generally are able to do hard work as well as normal cases, and it was my impression that there was very little risk in accepting this man.

3. Tachycardia: This class of cases presents the greatest difficulty in deciding the question of disposition. There are so many factors which influence the pulse-rate that no hard-and-fast rules can be adopted. It must always be borne in mind that the recruit is not at his best on the first examination. Sometimes he is examined on the day of his arrival in camp, sometimes he has just had his large noonday meal, and sometimes he has not had any dinner. Under any condition the recruit on his arrival is very nervous, he is living under conditions entirely foreign to his previous life, and the ordeal of passing through the hands of successive examiners reacts on his cardiovascular system to a disconcerting extent.

For the most part our men have been already examined by the tuberculosis board and have been put through breathing tests which increase their heart rate, but at the same time are directly to the advantage of the cardiovascular board, as tuberculosis is immediately eliminated as a cause for the tachycardia. Some of these men do not react well to the exercise test if the criterion is the pulse-rate after resting two minutes. When a good physical specimen fails to exhibit a pulse-rate below or the same as that shown in the pre-exercise period, he is put aside, and told to lie quietly for a time. Very often at the end of five or ten minutes the pulse-rate becomes normal; not infrequently we examine at the end of fifteen or twenty minutes.

The previous medical history of our accepted cases of tachycardia is as follows:

Tonsillitis	32
Pneumonia	19
Rheumatism	17
Syphilis	10
Diphtheria	4
Chorea	2
Scarlet fever	1

Immoderate smoking was found in 7 men, excessive use of alcohol in 4.

Symptoms occurred as follows:

Palpitation	64
Dyspnea	59
Pain	54
Giddiness	49
Fainting	19
Edema	14

The average pulse-rate was 123, and blood-pressure was 134–90.

When a definite cause for the tachycardia was supposedly found, it was due to—

Tobacco	17	times
Nervousness	12	"
Alcohol	5	"
Hookworm	1	time
Fever	1	"
Asthma	1	"
Recent illness	1	"
Dysentery	1	"
Malaria	1	"
Syphilis	1	"
Fibrosis	1	"
Active tuberculosis	1	"
Medication	1	" (taken to avoid acceptance, probably atropin).

Other phenomena associated with the tachycardia were:

Tremor	5
Sinus arhythmia	4
Apex systolic	2
Extrasystoles	2
Pulmonary systolic	2
Pallor	2
Dyspnea	1
Cyanosis	1

4. Extrasystolic arhythmias: Contrary to the general impression, there were more extrasystolic arhythmias than sinus arhythmias, leading one to the conviction that it is not an arhythmia peculiar to old age alone, but is a rather frequent occurrence in men under thirty years of age. It was met with in 37 cases, 33 of whom were accepted for military service. The extrasystolic arhythmia in all the accepted cases disappeared after exercise (hopping on one foot 100 times). When it did not disappear, but became more pronounced and was associated with poor exercise response, the cases were rejected.

Previous medical history:

Tonsillitis	9		
Pneumonia	6		
Syphilis	5		
Rheumatism	3	Immoderate tobacco	8

Symptomatology:

Palpitation	18
Dyspnea	15
Pain	10
Giddiness	10
Edema	3

The average pulse-rate was 96 and the average blood-pressure was 138–86.

Other phenomena:

Apex systolic	2
Pulmonary systolic	1

The ratio of extrasystoles to the pulse-rate was once every 4 beats in the majority of cases.

5. Hypertrophy without hypertension: The majority of these cases were accepted (18 out of 22), the rejected cases showing poor response to exercise:

Previous history:

Pneumonia	7		
Tonsillitis	5		
Syphilis	2	Immoderate smoking	5

Symptomatology:

Palpitation	10
Pain	9
Dyspnea	8
Giddiness	6
Fainting	3
Edema	3

Other phenomena:

Apex systolic	1

Average pulse-rate before exercise 96; after exercise (two minutes), 87. Average blood-pressure 134–87.

7. Functional cardiovascular disorder: It is a difficult matter in recruits to decide between functional cardiovascular disorders or effort syndrome, on the one hand, as a diagnosis, or simple tachycardia on the other, and the line is by no means sharply drawn. There is no doubt that we have included under tachycardias some functional cardiovascular disorders, but discrimination has been exercised as far as lay in our power.

Previous history:
- Tonsillitis..... 1
- Pneumonia..... 1

Symptomatology:
- Giddiness..... 5
- Dyspnea..... 4
- Palpitation..... 2
- Fainting..... 2
- Pain..... 1
- Edema..... 1

Other phenomena:
- Hookworm..... 2
- Slight thyroid tumor..... 1
- Slight edema..... 1

Average pulse-rate 118; after exercise (two minutes), 103. Blood-pressure 127–92.

8. Hyperthyroidism (9 of the 18 cases were from Ohio and Illinois):

Previous history:
- Tonsillitis..... 4
- Rheumatism..... 3
- Pneumonia..... 2

Immoderate tobacco..... 4

Symptomatology:
- Palpitation..... 7
- Dyspnea..... 3
- Pain..... 2
- Giddiness..... 2
- Edema..... 2

Associated signs of thyroid involvement:
- Tumor..... 14
- Exophthalmos..... 8
- Tremor..... 6
- Diarrhea..... 1

Average pulse-rate 93; after exercise (two minutes), 94. Blood-pressure 134–77.

The rejected cases were differentiated from the accepted cases by the presence of marked thyroid enlargement, marked hypertrophy and marked tachycardia, and poor response to exercise.

Very few of the accepted cases showed hypertrophy to any extent.

9. Simple goiter: When the thyroid enlargement is not disfiguring and is not associated with any marked signs of hyperthyroidism, they should be accepted.

MENINGOCOCCIC PERICARDITIS, WITH REPORT OF 12 CASES. MEDICAL SERVICE OF THE BASE HOSPITAL, CAMP JACKSON, S. C.

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For a satisfactory understanding of the complications of epidemic cerebrospinal meningitis a proper knowledge of the fundamental nature of the disease is necessary. Such knowledge has undergone considerable change within the past year. This change is the result of a study of the disease under the unwonted conditions of military life.

The result of the study of epidemic cerebrospinal meningitis in the camps has been the quite definite establishment of the disease as primarily a meningococcic sepsis, a blood-stream invasion from the initial focus in the upper air-passages with usual but not constant localization in various susceptible parts of the body (1), (2), (3). The most common site of secondary localization is, of course, the meninges. In our experience this meningeal localization has followed the general meningococcic sepsis in 96 per cent. of the cases; next in frequency the lung, the joints, the eye, the serous membranes, the testicle and epididymis, and the endocardium are involved.

In an epidemic of 280 cases observed at the Base Hospital, Camp Jackson, South Carolina, there were 12 examples of pericarditis. These present many points of clinical and pathologic interest. Brief case reports follow:

Case 1.—Tilley. Serial No. 3643, was admitted to the Base Hospital December 20, 1917, giving history of a chill on the previous day, with nausea, repeated vomiting, and a feeling of general soreness. On admission he complained of frontal headache and that he was "sore all over." His temperature was 99.2° F.;

the pulse, 84. He presented the symptoms and signs of a mild epidemic cerebrospinal meningitis. The spinal fluid contained meningococci. He ran a typical course of a mild case of epi-

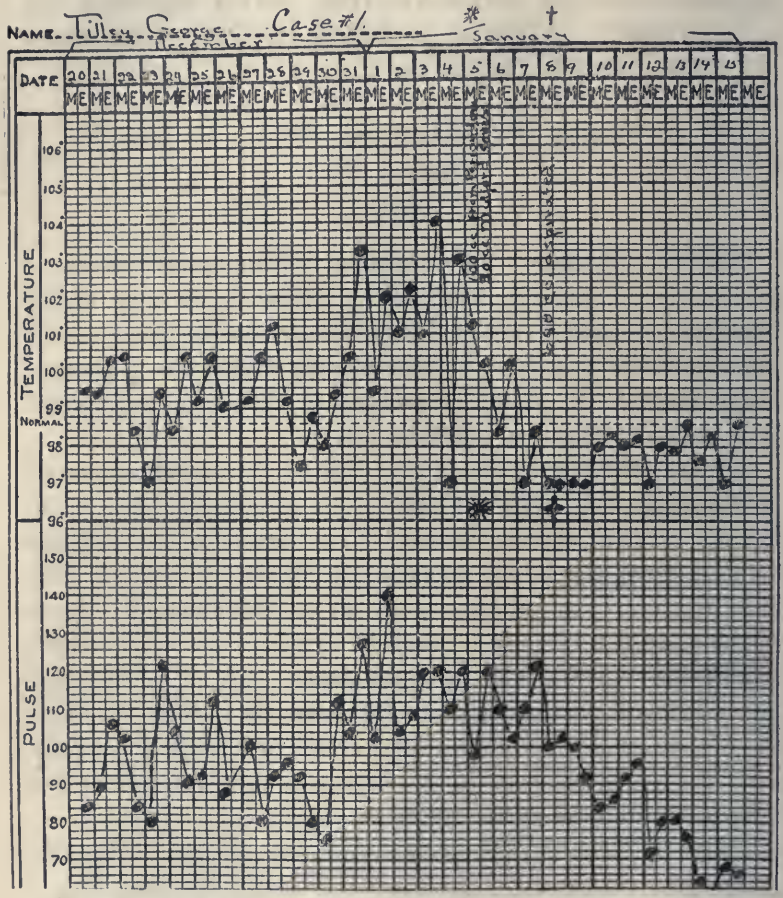

Fig. 80.—Temperature record in a case of meningococcic pericarditis with large effusion. *, 125 c.c. aspirated from pericardium; 30 c.c. antimeningococcic serum injected. †, 640 c.c. aspirated from the pericardium.

demic meningitis except that an irregular temperature persisted during convalescence and increased to 104° F. on January 3d. On January 5th there were signs of a considerable pericardial effusion. There was dyspnea and slight cyanosis. The right

border of the heart was 2 inches from the right edge of the sternum, the left border 1½ inches beyond the left nipple. The sounds were muffled and indistinct. There were no frictions. Aspiration in the fourth right interspace about 1 inch from the sternum gave bloody purulent fluid which on smear and culture showed meningococci; 125 c.c. of fluid was removed; 30 c.c. of antimeningococcus serum was introduced into the pericardium without discomfort or reaction. On the following day the temperature fell to 101.2° F. On the 6th it fell to normal and remained so. The pulse-rate more gradually returned to normal.

Five days after the first aspiration there were signs of returning pericardial effusion. Aspiration by Captain E. W. Barron, M. C., gave 640 c.c. of purulent fluid containing large numbers of fibrin flakes. No micro-organisms were found either on microscopic examination or on culture (Fig. 80).

Convalescence was prolonged because of tachycardia and dyspnea upon effort. After treatment in the cardiac ward by rest and suitable graduated exercises the patient made a complete recovery and returned to full duty. There was no evidence of pericardial adhesion. The heart retained a normal amount of mobility, was not increased in size, and on careful fluoroscopic and roentgenographic study showed no evidence of adhesions to the diaphragm or other structures.

Case 2.—Stevenson. Serial No. 5460. Colored. Civilian, sixteen years old. This patient was admitted to the Base Hospital January 22, 1918. He was unable to give any intelligent answers to questions because of the stuporous condition, but presented the clinical picture of a severe cerebrospinal meningitis which was confirmed by lumbar puncture when meningococci were demonstrated. There was paralysis of the right face and divergent strabismus. A pericardial friction developed on January 25th. The patient responded to treatment and made a complete recovery, being discharged to duty March 1, 1918, without any evidence of permanent cardiac or other damage.

Case 3.—Robinson. Serial No. 3190, was admitted to the Base Hospital on December 27, 1917. On the morning of December 26th he felt nauseated and later in the day had severe

frontal headache. He remained in quarters. On the following day he was brought to the Base Hospital as a case of meningitis. On arrival he was stuporous and could give no definite history. The pharynx was congested, petechiæ were found over the extremities, the neck was rigid, and Kernig's sign positive. On admission the temperature was normal, the pulse-rate 126. The spinal fluid was cloudy and contained meningococci. A total of 365 c.c. of antimeningococcus serum was injected into the spine and 170 c.c. into the vein. He showed as a complication a right epididymitis and orchitis. There was moderate temperature, with 101° F. as a maximum, and a rather rapid irregular pulse, gradually developing the symptoms and signs of blocking of foramina with hydrocephalus. On January 7th he developed a loud to-and-fro pericardial friction and had the signs of a patchy consolidation over the bases of the lower lobes. On January 9th arthritis of the right shoulder appeared, also a moderate torticollis. The signs of small areas of consolidation of the lung remained. Pericardial frictions were present and arthritis of the right knee. On February 3d the right knee-joint was aspirated and 42 c.c. of cloudy fluid containing meningococci removed; 15 c.c. of Lederle antimeningococcus serum were injected into the joint. The patient continued to decline in strength, the mind became clouded, and emaciation increased. February 10th, while being examined, the patient suddenly became cyanotic and ceased breathing. Lumbar puncture was performed and about 12 c.c. of organge-colored fluid was removed, not under pressure. Voluntary respiration did not return and life was maintained by artificial respiration. Cervical puncture was made in the midline at a level of the tips of the mastoid processes or between the atlas and occipital bone, the needle passing upward into the posterior segment of the foramen magnum. Fluid shot out under marked pressure. At first it was clear, later turbid and blood tinged. About 100 c.c. were removed. At this time voluntary respirations were resumed apparently as a direct result of the reduction of intracranial pressure. Later another cervical puncture was performed at the same site as before and 15 c.c. of bloody

fluid withdrawn. The patient's condition became more serious and death followed. At necropsy the body was thin, emaciated, the cheeks sunken. The thoracic cavity showed the remains of the thymus gland. There were a few adhesions at the apex and base of the left lung with bronchopneumonia of the upper lobe of the right lung. The heart showed general fibrinous pericarditis and rather large shaggy masses of partly organized fibrinopurulent exudate. The endocardium was not examined. The spleen was slightly enlarged and congested. The liver, of normal size, was slightly pale in color. The pancreas was normal. The kidneys were normal in size, with slight cloudy swelling and moderate congestion. Brain: The inferior surfaces of the cerebellar hemispheres were pyramidal in shape and surrounded by a ring of depression from forcible contact with the margins of the foramen magnum, into which the pointed pyramids protruded. A continuous blood-clot, firmly attached to the lower surface of the right cerebellar hemisphere, extended through the fourth ventricle, the aqueduct of Sylvius, and into the third ventricle. This clot was dark and firm. No free blood was present in the ventricles or beneath the cerebellum. The lateral ventricles were greatly dilated in all directions, including the horns. The dura mater was thin, pink, and not adherent. The blood-vessels of the pia mater were prominently distended over the cerebral and cerebellar hemispheres. The convolutions of the cerebral hemispheres were flattened and the sulci greatly lessened in depth. There was no purulent exudate.

Diagnosis.—1, Acute hydrocephalus; 2, recent hemorrhage from the inferior surface of the right cerebellar hemisphere into the fourth ventricle, iter, and third ventricle; 3, cerebellar plugging of the foramen magnum or cerebellar hernia; 4, right upper lobe bronchopneumonia; 5, subacute adherent pericarditis; 6, subacute pleural adhesions.

Case 4.—Cockerhan. Serial No. 4196, was admitted to the Base Hospital January 14, 1918, giving a history of four days of general aches and pains. The temperature on admission was 100° F. He showed all the evidences of a severe well-advanced

epidemic cerebrospinal meningitis, with cloudy spinal fluid containing meningococci. On January 15th severe arthritis of the right knee and both wrists developed, with milder symptoms in other joints. There was a marked hemorrhagic rash and a rapidly developing left panophthalmitis. On January 21st he developed signs at the angle of the left scapula suggesting consolidation. The temperature rose to 102° F., the pulse to 162. He died on January 24th. He was given a total of 315 c.c. of antimeningococcus serum intraspinally and 125 c.c. intravenously.

Necropsy.—The body was that of a well-nourished male with left panophthalmitis. Both lungs were crepitant throughout, but showed passive congestion and hypostatic pneumonia. Heart: The pericardial sac was filled with a thick, well-organized, shaggy, fibrinopurulent exudate firmly attached to the visceral as well as the parietal pericardium, and covering the entire heart. The masses of exudate were astonishingly large, some being as much as 2 inches thick. The exudate was of a light yellow tint and very dense. The picture was that of a "shaggy" or "bread-and-butter heart" of an exaggerated degree. The pericardium contained no free fluid. The spleen and the liver showed passive congestion; the kidneys, acute cloudy swelling. Brain: There was a purulent exudate on the vertex along the longitudinal sinus. The cortex was hyperemic. Upon opening the duodenum an acute hemorrhagic duodenitis was seen.

Diagnosis.—1, Epidemic cerebrospinal meningitis; 2, shaggy fibrinopurulent pericarditis; 3, acute hemorrhagic duodenitis; 4, parenchymatous nephritis.

Case 5.—White. Serial No. 4166. This patient was admitted to the Base Hospital January 1, 1918. On the previous day he had a chill followed by fever. He complained of pain in the small of the back and frontal headache on the morning of January 1st. He remained in bed prostrated, and later in the day was sent to the Base Hospital. On admission his temperature was 100.2° F. The spinal fluid was cloudy and showed meningococci. The patient ran the course of a moderately severe epidemic cerebrospinal meningitis. On January 15th

there was the development of facial erysipelas, with a faint friction-sound over the precordium. On January 19th the patient became stuporous and died.

At autopsy the body was emaciated, showed thickened skin on the left side of the face, with some vesiculation. The appendix and gall-bladder were bound down by adhesions. The liver was adherent to the diaphragm by an adventitious membrane. The spleen was soft and mushy. The liver was soft, with large areas of cloudy swelling and beginning fatty change. The kidneys showed cloudy swelling and early fatty degeneration. Heart: There was no excess of pericardial fluid. On the outer surface of the left ventricle near the apex there was a patch of organized purulent exudate about 2 cm. in diameter. Lungs: The right showed firm pleural adhesions from the upper and lower lobes to the lateral chest wall. In the left lung there were firm organized adhesions with a few patches of bronchopneumonia in the upper and lower lobes and hypostatic congestion in the lower lobe posteriorly. Brain: There was a large amount of coagulated purulent exudate closing the foramen magnum. Over the superior surface of the cerebellar hemispheres and vermis there was well-organized exudate of the same nature. The brain tissues were exceedingly soft. There was purulent exudate over the cortex of the parietal regions; the convolutions were flattened, the sulci shallow. The veins of the pia were deeply turgescent and large. The cortex was hyperemic. The lateral ventricles were distended, containing thick, creamy yellow purulent exudate, covering the choroid plexus of each lateral ventricle. The foramina of Munro had a strand of purulent exudate of the same character extending through each foramen. The third ventricle was filled with the same sort of exudate. The right sphenoidal sinus contained pus of a like description.

Diagnosis.—1, Epidemic cerebrospinal meningitis; 2, chronic adhesive pleuritis; 3, fibrinopurulent pericarditis; 4, epidemic cerebrospinal meningitis of the base; 5, bronchopneumonia, left lung; 6, erysipelas, facial; 7, sphenoidal sinusitis, purulent.

CASE 6.—Denson. Serial No. 3211. This patient was ad-

mitted to the Base Hospital December 6, 1917, in an unconscious condition. There was projectile vomiting, a petechial rash, Kernig's sign, stiff neck, and an extremely weak and rapid heart. The condition was one of collapse. There was general cyanosis. The lungs showed moisture at both bases, with many subcrepitant râles. There was a rapidly developing panophthalmitis of the right eye. The temperature was normal, the respiration 38, and the pulse imperceptible. The spinal fluid was cloudy and showed meningococci. A total of 110 c.c. of antimeningococcus serum was injected intraspinally. The condition rapidly became more grave, bilateral choroiditis appeared, and on December 10th the patient died. No signs of pericarditis were detected during life.

Necropsy.—The body was emaciated and was dotted with a marked general petechial rash. Eyes: Suppurative choroiditis. Brain: The dura was markedly congested, as was the pia, and was adherent in spots to the cortex of the anterior lobe. Gray purulent fluid was present over the entire surface of the cortex. Both hemispheres were congested. The lungs showed passive congestion. The pericardium was distended by about 600 c.c. of yellow purulent fluid containing flakes of fibrin. Heart: Enlarged, the right auricle being markedly distended with clotted blood. The surface of the heart was covered with a fibrinous coat. The valves were normal. The liver was congested, though normal in appearance; the gall-bladder was distended with bile. The kidneys showed passive congestion. The peritoneum was actively congested from early peritonitis.

The *anatomic diagnosis* was as follows: 1, Epidemic cerebrospinal meningitis; 2, suppurative choroiditis; 3, acute fibrinous pericarditis; 4, acute peritonitis.

Case 7.—Pope. Serial No. 2909. This patient was admitted to the Base Hospital on December 1, 1917, giving a history of a sudden onset November 30th of chill, fever, severe headache, and repeated vomiting. The next morning the patient was brought to the Base Hospital as a case of meningitis. The temperature on admission was 96° F. On December 2d there were numerous petechial spots, a stiff neck, positive Ker-

nig's sign, and unequal knee-jerks. The spinal fluid showed meningococci. The temperature was moderate, the maximum being 103° F. The course of the fever was very irregular. Left panophthalmitis developed, with complete loss of vision in that eye. Death occurred December 22, 1917.

Necropsy.—The body was thin and emaciated. Brain: The dura was markedly congested, as was the arachnoid. The cortex was bathed in purulent gray fluid. Clots of yellow pus were present around the surface of the brain. The ventricles were filled with fluid, the foramina clogged with purulent fluid. Heart: The parietal and visceral pericardium are adherent by recent fibrinous exudate.

Diagnosis.—1, Epidemic cerebrospinal meningitis; 2, hydrocephalus from blocking of foramina; 3, pericarditis.

Case 8.—Pack. Serial No. 3191. This patient was admitted to the Base Hospital on December 17, 1917, with a diagnosis of measles. He showed photophobia, headache, and general soreness of the body. On December 22d a diagnosis of epidemic cerebrospinal meningitis was made because of the stuporous condition, the frontal headache, the petechial rash, and unequal exaggerated reflexes. Bronchopneumonia developed very rapidly and proved to be a terminal event, death occurring December 28th. Meningococci were found in the spinal fluid and intraspinal treatment was given. No evidence of pericarditis was discovered during life.

Necropsy.—The body was thin and emaciated. A petechial rash was present about the face and neck and a diffuse purpura covered the back. Brain: The dura and arachnoid were markedly congested. The brain surface was congested and bathed in a thin gray purulent fluid. Thin gray fluid containing fibrin clots was found in both lateral ventricles. Lungs: The right base was adherent to the pleura. There was lobular pneumonia of the right lower lobe. The base of the left lung was adherent over the entire lower lobe. Heart: The pericardium was filled with about 100 c.c. of yellow cloudy fluid and flakes of fibrin. The heart was normal. The liver, spleen, and kidneys were enlarged and showed passive congestion.

Diagnosis.—1, Fibrinous pleurisy; 2, fibrinopurulent pericarditis; 3, lobular pneumonia; 4, epidemic cerebrospinal meningitis.

Case 9.—Buchanan. Serial No. 4801. This patient was admitted to the Base Hospital on January 12, 1918. The illness began suddenly on that day, with general malaise and headache, sore throat, and pains "all over." The temperature was 104.2° F.; the pulse, 120. On January 13th he was transferred to the meningitis ward markedly prostrated. There was a profuse purpuric rash over almost the entire body. The neck was moderately stiff and Kernig's sign was present. The spinal fluid was cloudy and showed meningococci. He received a moderate amount of serum intravenously and seemed to make some improvement. Left panophthalmitis developed on December 14th. On the 15th he became restless; petechial rash and purpuric blotches appeared on the thighs; Kernig's sign was positive and subcrepitant râles were found at both bases. The patient died on the same date.

At *necropsy* the body was well nourished and well developed. Many petechial spots and a hemorrhagic purpura with conjunctival hemorrhages were present. There was hypostatic congestion of the lungs. The heart was negative, but the pericardial sac contained fibrinopurulent fluid on both visceral and parietal surfaces. Brain: There was thin purulent fluid in the subarachnoid space on each side of the median longitudinal sinuses, also on the median surface of the cerebral hemispheres, the superior surface of the cerebellum, especially over the median part. There was no purulent fluid in the ventricles. The choroid plexus of each lateral ventricle was congested and showed several small cysts.

Diagnosis.—1, Epidemic cerebrospinal meningitis; 2, fibrinopurulent pericarditis.

Case 10.—Romaquera. Serial No. 3604. This patient was admitted to the Base Hospital December 19, 1917, unconscious and in very poor condition. The body was dotted with petechiæ. There was congestion of the bases of both lungs, rigidity of the neck, and spastic paresis of the left arm and left

leg. The temperature on admission was 102.4° F. and remained elevated until his death, December 24th. During the latter part of the illness there was partial paraylsis of the left side of the face and the left arm. Intraspinal and intravenous treatment was given. The spinal fluid was positive for meningococci. No signs of pericarditis were detected during life.

At *autopsy* the body was thin and emaciated. The skin was covered with a purplish-brown hemorrhagic rash. Brain: The dura was congested and distended. The arachnoid vessels were numerous and congested. The cortex showed a small amount of thin yellow fluid over the vertex, especially along the fissure of Rolando—more on the right than on the left. The convolutions were flattened, but soft. There was no pus or excess of fluid in the ventricles and no exudate over the base of the brain. Heart: The parietal pericardium was covered by a thick yellow fibrinopurulent exudate. About 40 c.c. of pus were found in the pericardial sac. Lungs: The lower lobes showed marked hypostatic congestion.

Diagnosis.—1, Epidemic cerebrospinal meningitis; 2, purulent pericarditis; 3, hypostatic congestion of the lungs.

Case 11.—McLeod. Civilian carpenter, forty years of age. This patient was admitted to the Base Hospital on May 27, 1918, with a temperature of 97.6° F. and a pulse-rate of 94. He was cyanotic and thickly dotted with petechial spots and larger purpuric areas. He was apathetic, his head was not retracted, but the neck was stiff. Kernig's sign was positive. The heart and lungs were negative. The patient was stuporous and drowsy. He received vigorous intraspinal and intravenous treatment. On May 29th he was semicomatose and showed weakness of the left external rectus. The lungs were congested at the bases. There was an acute polyarthritis, involving wrists, ankles, and knees. The temperature rose to 104° F. at death on May 29th. The spinal fluid and blood-culture were positive for meningococci.

At *necropsy* the body was that of a well-developed man with marked postmortem lividity. Over both feet and hands were subcutaneous hemorrhages, some ¾ inch in diameter. Brain:

There was moderate bulging of the dura, with engorgement and lymphoid deposit along the sulci. Between the cerebellum and cerebrum there were numerous fibrinous adhesions. At the extreme base were several small masses of yellowish pus with marked congestion. The congestion of the choroid plexus was also extreme, but there was no excess of fluid in the lateral ventricles. Numerous petechial hemorrhages were found along the walls of the lateral ventricles. The brain was slightly softer than normal. Lymph-nodes: There was moderate congestion and softening of the tracheobronchial nodes. Pleural cavities: The left pleural cavity was completely obliterated by marked fibrous adhesions. The right pleural cavity showed fibrous adhesive pleuritis. There was moderate fatty change in the aorta. The pericardial sac contained 50 c.c. of yellow creamy pus. The visceral pericardium was roughened by tags of fibrin very loosely attached and showed numerous petechial hemorrhages. Heart: Posteriorly there was marked engorgement of the vessels of the heart. The valves were normal. The myocardium was rather soft and dark in color. Spleen: Moderate enlargement and softening. Liver: Moderate fatty change. Stomach: Contains a large amount of watery material. Lungs: Right pleural surfaces smooth and glistening except for the posterior and lateral surfaces, which are covered with fibrinous tags. The lung is crepitant throughout. On section the tissue was found normal in appearance except for marked hyperemia. The left pleural surfaces were torn throughout and markedly congested.

Diagnosis.—1, Epidemic cerebrospinal meningitis; 2, fibrinopurulent pericarditis; 3, bilateral pulmonary hyperemia; 4, right posterior and lateral fibrinous pleuritis, left complete obliterating fibrous adhesive pleuritis; 5, marked gaseous distention of the bowels; 6, early fatty degeneration of the liver; 7, enlargement and softening of the spleen.

Case 12.—Chestnut. Serial No. 18,397. This patient was admitted to the Base Hospital on June 27, 1918, suffering from nausea, vomiting, headache, and coryza. The temperature was normal. Measles developed, which ran a normal course until

July 5th, when there was chill and rise in temperature to 102° F. The patient became semicomatose, a petechial rash appeared, and there was stiffness of the neck. The pulse was feeble. The apex of the heart was in the nipple line; the rate 140, regular, and with a marked gallop rhythm and some pulse deficit. The spinal fluid was removed under pressure, but was clear, showed no pus-cells, no organisms, and only a faint trace of globulin. It later became cloudy, but never showed meningococci. The blood-culture of July 6th was positive for meningococci. The patient gradually developed hyperpyrexia, cyanosis, and later collapse. A very profuse hemorrhagic rash appeared and the patient died July 9, 1918.

At *necropsy* the body showed numerous purpuric spots on the trunk and extremities. Brain: The surfaces were deeply congested, but there was no evidence of meningitis. The choroid plexus was very markedly congested and there was much bloody fluid in each lateral ventricle. The serous membranes showed small petechial spots on both visceral and parietal surfaces. Kidneys: Moderate cloudy swelling. The spleen was large and soft. Lungs: Each pleural cavity contained 650 c.c. of amber colored fluid. The pericardial sac contained 30 c.c. of cloudy yellow fluid containing fibrin and pus. There were numerous petechial spots over the pericardial surface. There was complete consolidation of the right upper and lower lobes, also of the left lower lobe. The heart was quite flabby, but there was no abnormality of the endocardium or valves. The muscle was pale and cloudy.

Anatomic Diagnosis.—1, Acute fibrinopurulent pericarditis; 2, acute diffuse nephritis; 3, bilateral hydrothorax; 4, cloudy swelling of the parenchymatous organs; 5, acute splenic tumor; 6, purpuric skin eruption; 7, confluent pseudolobar bronchopneumonia; 8, epidemic cerebrospinal meningitis.

SUMMARY

Frequency.—In an epidemic of 280 cases there were 12 examples of pericarditis, a percentage of 4.29.

Types of Cases in which Pericarditis Appears.—Pericarditis

is a complication of serious meningococcic sepsis. With but one exception the 12 cases of this series were extremely serious. Only one was mild. In an epidemic, the mortality of which was 24.8 per cent., the mortality in cases showing this complication was 83⅓ per cent. In other words, 10 of the 12 cases with pericarditis died.

Pathology.—Two types of meningococcic pericarditis may be described—the wet and the dry. Of the 12 cases here reported, there were 6 of each type. The amount of exudate was large in 2 cases, small in 4. The largest effusion amounted to 640 c.c., the next to 600 c.c., the rest to 100 c.c., 50 c.c., 40 c.c., 30 c.c., in order. The exudate was either a bloody, purulent, rather thin fluid containing small or large flakes or masses of fibrin, or a thick creamy yellow mixture of pus and fibrin. The large effusions were of the first-named type. Meningococci were present in most of these fluids. The exudate in the dry variety was fibrinopurulent in character, fibrin predominating. This fibrin varied in amount from a plaque 1 inch in diameter to the most exaggerated kind of "shaggy" or "bread-and-butter" heart. In one case the masses of fibrin were of almost inconceivable size, so that when retracted the pericardium in both visceral and parietal layers was covered by masses of shaggy yellowish-white exudate, some as much as 2 inches in diameter. The exudate in this case was much more massive than one ever sees it in cases of pneumococcic pericarditis.

Symptoms of meningococcic pericarditis are rarely as characteristic as those of the pericarditis of pneumococcic infections. Meningococcic pericarditis is merely a part of a severe systemic infection; its symptoms merge with those of the generalized disease. As a rule, these symptoms are high fever, a more rapid pulse, and a general increase in the toxemia. With the presence of a large effusion the expected symptoms and signs of this physical condition appear, and are not in any way peculiar. The pulse-rate in the series reported during the period of pericarditis averaged 124; varying from 84, the lowest, to 162, the highest; 10 of the 12 cases had petechiæ; 4 had positive blood-culture; 7 of the 12 cases had other severe meningococcic com-

plications—panophthalmitis, purulent arthritis, peritonitis, bronchopneumonia, paralyses, or hydrocephalus. But 4 of the 12 cases were discovered during life; 8 were discovered only at necropsy. The time of occurrence of the pericarditis of epidemic meningitis is important. One case developed one week after onset; another, three weeks; the remainder between these extremes. The cases showing dry pericarditis developed earlier than those with the large thin sanguinopurulent effusions, which occurred later in the course of the illness. In general it may be said that pericarditis is a feature of the late period of the acute stages of the disease. The effect on the heart of those cases that recover is important. Of the two cases making recovery, one was of the dry type, the other had a large effusion. The former made a prompt recovery without subsequent cardiac embarrassment, the second recovered only after a prolonged period of convalescence in which there was dyspnea and other evidences of moderate cardiac insufficiency. The final result, however, was excellent and the return to health apparently complete. Of interest in this case was the lack of proof of the existence of adhesions.

Diagnosis in this as in most conditions depends upon keeping the possibility in mind. Every case of severe meningococcic sepsis should be regarded as a potential pericarditis. The heart outline should be carefully noted so soon as a patient comes under observation and subsequent changes in shape or size noted. Appearance of a friction over the precordium should immediately make one alive to the condition, so also should much acceleration of the pulse-rate, dyspnea, increase in the size of the veins of the neck, cyanosis, or other well-known evidences of pericarditis. With any increase in the severity of general toxemia one should be alert. With evidence of accumulation of fluid, exploratory puncture should be made in the usual way. A possible source of error in puncture is the plugging of the needle from the flakes of fibrin which are so commonly seen in the meningococcic exudate. One should be prepared for the injection of serum when the exploratory puncture is made.

Treatment.—Of primary importance is the treatment of the general disease. Since pericarditis occurs in those cases in which meningococcic sepsis is present, the intravenous serum treatment is our mainstay. This should be carried out according to the method suggested in previous communications (1), (2), (3). In brief, this is the administration by vein of antimeningococcic serum in doses of 100 to 150 c.c. every eight to twelve hours until the symptoms are under control. The local injection of serum is most important. In one case with effusion the pericardial sac was promptly sterilized and all the general symptoms—fever, dyspnea, etc.—promptly disappeared after a single injection of 30 c.c. of antimeningococcus serum. This case was a remarkable example of the persistence of a single focus of meningococcic infection continuing to act as a source of general disturbance after other signs and symptoms had subsided, and emphasized the importance of search for such foci in eye, joints, ear, epididymis, lung, pleura, or elsewhere in those cases not making satisfactory progress. The satisfactory effect of local serum therapy is also emphasized. Other general measures, as morphin and external applications, need but passing mention. The question of introducing serum into the pericardial sac in which there is presumably only the dry type of pericarditis present is debatable. It must be governed by the circumstances of each individual case. It is probable that serum so introduced would have good effect. The technical difficulties are, however, obvious.

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PAROXYSMAL TACHYCARDIA IN SOLDIERS, WITH REPORT OF CLINICAL AND POLYGRAPHIC STUDIES

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Of the total number of 13,000 cases in the Base Hospital at Camp Zachary Taylor before May 1, 1918, there were 120 discharged with cardiovascular diagnoses. In these cases no attack of paroxysmal tachycardia was recorded or observed during their sojourn in the hospital. Since then, during my association with the institution, I had the opportunity to study a series of cases both clinically and by means of the Mackenzie polygraph. Unfortunately, no electrocardiograph was available to assist in the analysis of the cardiac phenomena.

I desire to place 4 cases of paroxysmal tachycardia and 1 paroxysm of auricular flutter on record because they present the typical clinical pictures of this form of tachycardia and bring out clearly its military aspect as it is encountered in our camps.

Among the characteristic features of the disease are sudden onset of an attack, with marked increase in the rate of the heart's action and its sudden cessation after a variable length of time, with a marked fall in rate. The frequency and the severity of the attacks vary. Their cause, the effect of the attacks upon the size of the heart, and the rôle of the vagi in their control will be discussed later.

The pace-maker for the heart in these cases is located in an abnormal place in the cardiac musculature, and not at the sino-auricular node. The site of origin of the abnormal rhythm may be supraventricular, in the auricular wall or the junctional tissue, or in the ventricular musculature. In these cases the

rhythm is regular. Paroxysmal tachycardia with total arhythmia is usually associated with fibrillation or standstill of the auricles. When the rhythm is regular the extrasystole, or premature contraction, is the unit out of a series of which an attack of paroxysmal tachycardia is comprised. The rate of auricular contraction varies from 150 to 300 per minute. There are cases in which it is not possible to state the nature of the attacks without electrocardiographic studies.

The pathology of the disease is as varied as its clinical varieties. In Falconer and Duncan's case the paroxysms originated in the junctional tissues. Postmortem an acute inflammatory lesion was discovered beneath the aortic valves, involving the middle third of the main stem of the a-v. bundle. Of 3 cases reported by Butterfield and Hunt, microscopic changes were found in 2 in the region of the sino-auricular node and in the third in the interventricular septum. These findings corresponded to the sites of origin of the paroxysms as diagnosed from the electrocardiograms. Leukocytic infiltrations due to rheumatic fever or syphilis or in the acute infections may be a source of origin for the attacks.

Two types of paroxysm are presented in this paper. In the first 4 cases the rate is very much increased over the normal and the heart-beat is regular. In each of these the origin of the attacks is at an abnormal site in the auricular musculature. In the fifth case the attack is due to auricular flutter. Though apparently irregular and at times slow, a certain regularity becomes manifest on analysis of the tracings, and an extremely high auricular rate is discovered.

The importance of the graphic observations in studying these cases cannot be overestimated. The great value of testing the functional capacity of the circulation in these cases to determine their proper disposition from a military standpoint are subjects of essential interest and importance at the present time.

Case I.—Attack of paroxysmal tachycardia lasting seventy-two hours; pulse-rate reached 246 per minute; high temperature; cardiac dilatation; good functional capacity in the intervals between attacks.

Private O. O. K., aged twenty-three, arrived at Camp Zachary Taylor, Kentucky, on April 27th and pursued the usual drilling maneuvers without any discomfort.

Past History.—He was previously a railroad signaller, an occupation that entailed moderately heavy work. He had mumps, chicken-pox, and measles as a child, but no other illnesses or operations, and gave a negative venereal history. His family history was negative and his habits were good.

Previous History.—Since he was sixteen years old the patient suffered from occasional attacks similar to the one to be described. He had perhaps five or six within seven years, but was entirely free from them for two years before admission. The attacks were not induced by exertion and presented no apparent cause. They lasted a variable length of time, from several hours to perhaps one or two days. The first paroxysm came on while playing snow-ball. After each attack, for a few days, the patient felt a soreness of the muscles and tissues of the precordium.

Present Attack.—An attack began suddenly at 4.45 P. M. of May 14th while playing ball. The effort was not unusual and there was no apparent reason for the sudden onset of palpitation. The patient had a sense of precordial pressure, fulness in the throat, and some shortness of breath. He lay down in the field to rest, but, as the dyspnea continued, he was admitted to the Base Hospital.

Physical Examination.—On admission, the examination showed the patient in good general condition, with clear and rather alert mentality. There was no cyanosis; the respirations were a little over 20 a minute.

The pulse was too rapid to be counted digitally. It was 208 beats a minute. It was markedly unstable and fluctuating in pressure and volume, but it maintained a perfect rhythm. The blood- and pulse-pressures were very low; the systolic pressure was 90 mm. and the diastolic was 74 mm. of mercury by the vertical manometer reading. The systolic pressure fell during inspiration to 78 mm. of mercury and rose with expiration. This is well illustrated in the polygraphic tracings.

The heart showed no abnormalities besides the extreme tachycardia. The left border and apex percussed two finger-breadths inside of the nipple line and 8 cm. from the median line. The upper border was located at the upper border of the third rib and the apex was in the fourth space.

The lungs were clear. Liver dulness extended from the fifth rib to the costal margin and the edge was not palpable. The spleen was not enlarged.

Course.—Polygraphic tracings were taken with the Mackenzie ink polygraph. They showed interesting curves, which are analyzed below.

Attempts were made to stop the paroxysm by vagus influence. Pressure on both eyeballs and on both vagi directly was attempted, but without effect. The hypersensitiveness of the patient made it difficult to carry out these measures satisfactorily. Fifteen minims of digalen had been given hypodermically; cold water was splashed upon the chest; the patient was given large pieces of ice to swallow; but these measures were of no avail. An ice-bag was therefore applied to the precordium and to the neck and tincture of digitalis was administered in doses of 15 minims every four hours.

On the following day the heart rate had increased to 216 beats a minute and an unusual feature developed. The mouth temperature rose during the day from 99.4° to 103° F., and ran the course shown in the accompanying chart (Fig. 81), falling to normal at the end of the attack. The explanation for the fever is doubtful. Perhaps it resulted from the tachycardia as a central thermogenetic manifestation, but one cannot assert this with any assuredness. There could be found no other obvious reason for the high temperature.

The following day the pulse-rate was 235 a minute. The radial pulse showed plainly the fall of pulse volume with inspiration. Toward evening the breathing became periodic, somewhat of the Cheyne-Stokes character, but without restlessness or grunting.

At 4.00 P. M. of the next day, May 17th, the heart percussed enlarged over its original size. The left border was at the nipple-

line and 10 cm. from the median line and the right border percussed at the right sternal border. The apex-beat remained in the fourth space. The heart-rate was higher than before, beating 246 times a minute. There was no cyanosis. The respirations had been between 28 and 32 times a minute throughout the paroxysm. The liver was not enlarged nor tender and there was no edema. The patient had received up to this time 165 minims of the U. S. P. tincture of digitalis and 15 minims of digalen.

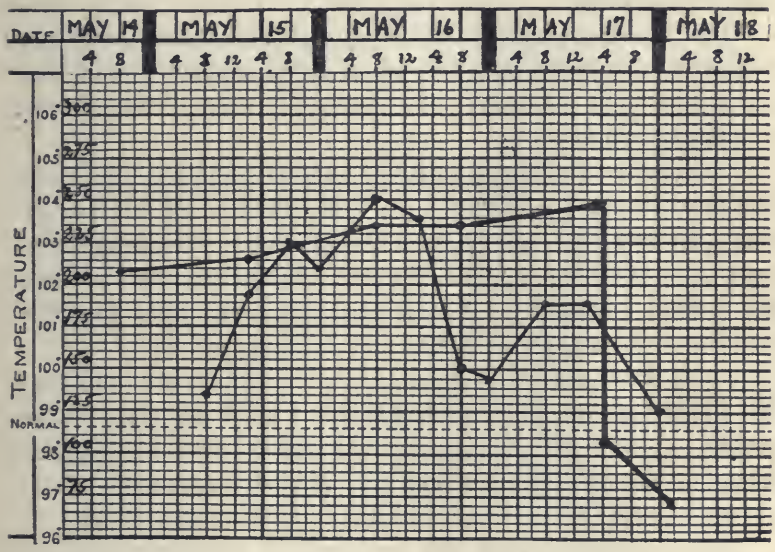

Fig. 81.—Temperature curve and heart rate during the period of the paroxysm. Note the sudden change of rate from 246 per minute to 106 and then to 68 per minute.

At 5.30 P. M., exactly one and a half hours after the last pulse tracings were made and just about seventy-two hours after the onset of the attack, the patient was found to have a remarkable reduction in pulse-rate—100 a minute. He had slept a little while, but had felt no unusual or notable symptoms.

The heart now also showed a striking difference from the examination of an hour and a half before. The left border had

receded to its original position, two fingerbreadths inside of the nipple, line and the right border returned to the midsternal line. The respirations slowed and the patient felt quite well. There was no arhythmia.

But after several hours a marked respiratory arhythmia was evident. The average pulse-rate now was 68 a minute. The systolic blood-pressure rose during expiration to 134 mm. and fell to 130 mm. during inspiration, but the diastolic pressure remained unchanged. The systolic pressure was quite stable after the attack.

The blood-count, urinalysis, and Wassermann test were negative. No radiogram was taken of the patient's heart during the attack. Two days after the *x*-ray examination showed a normal heart shadow.

Tests of the functional capacity of the circulation were made one week after the cessation of the attack while the patient was convalescing. No delayed rise of blood-pressure occurred even after 6000 foot-pounds of work. Table I (p. 433) presents the findings compactly. The patient was found unfit for overseas duty and was recommended for domestic service.

Polygraphic Study.—Polygraphic tracings were obtained with the Mackenzie ink polygraph four hours after the onset of the attack on May 14th. They showed the characteristic jugular curve of paroxysmal tachycardia. The site of origin of the abnormal rhythm was located probably in the auricular wall.

The phlebogram (Fig. 82) presents the ventricular form of curve with two well-marked waves: the larger *c* is due to ventricular systole and begins about midway up the ascending limb of the peak. The smaller wave is the *v*-wave. The auricular contraction is represented probably by the lower half of the *c*-rise. The *a*-*c* interval is less than one-tenth of a second. The undulating form of the radial curve is frequent in these cases. The cardiogram was of trapezoidal form, but otherwise showed nothing of note. The pulse-rate is 207 beats per minute. On May 15th the rate increased to 216 per minute (Fig. 83). The phlebogram is of the same character as before. The tracings taken from the apex of the heart, however, show a distinct

TABLE I

	S.	D.	S.	D.	S.	D.	S.	D.	S.	D.	S.	D.
Pulse-rate, seated	102		72		96		96				102	
Pulse-rate, standing	120		64		96		108				114	
Blood-pressure, seated	95	65	112	54	100	66	104	75	95	55	93	60
Blood-pressure, standing	106	68					105	75			105	75
Exercise performed[1]	Hopping 100 times		20 S. 30 2 feet		15 S. 40 5 feet		15 S. 50 5 feet		15 S. 75 5 feet		15 S. 80 5 feet	
Foot-pounds of work	2000		1200		3000		3750		5625		6000	
Pulse-rate immediately after	162						144		144		120	
Blood-pressure 30 seconds after	145	70	108		135		123	60	125	30	135	55
Blood-pressure 60 seconds after	140	70	103	50	130		123	60	115	50	135	65
Blood-pressure 90 seconds after	128	65	94		120		115	65	115	60	128	65
Blood-pressure 120 seconds after	120	70			120		108	70	110	60	120	70
Pulse-rate 2 minutes after	114						96				90	

[1] Hopping 100 times is the exercise prescribed by Circular 21 from the Office of the Surgeon General. The other tests were dumb-bell exercises performed according to the Barringer method. This patient weighed 135 pounds.

series of waves superimposed upon an irregularly trapezoidal form of curve.

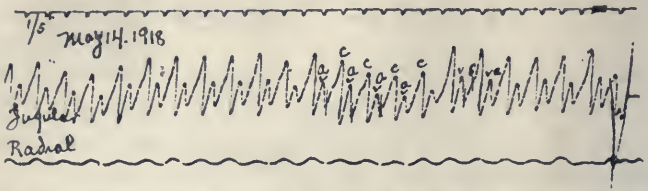

Fig. 82.—Simultaneous tracings of the jugular and radial pulses during attack of paroxysmal tachycardia. Note slight pulsus alternans in the radial tracing. The rate is about 208 a minute. In cases of paroxysmal tachycardia it is often very difficult to interpret satisfactorily the tracings obtained from the neck.

On the next day, May 16th, the pulse-rate was 235 a minute (Fig. 84). The radial curve shows more clearly than before the

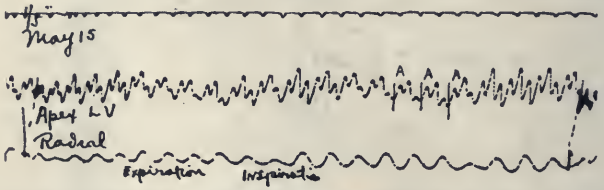

Fig. 83.—The cardiogram shows several waves, difficult of exact analysis. The rate is 216 a minute.

variation of blood-pressure and pulse-volume occasioned by inspiration and expiration. The fall of systolic blood-pressure occurs with inspiration.

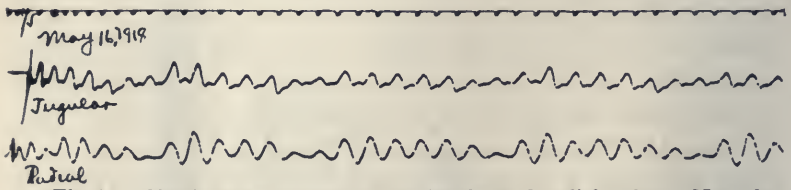

Fig. 84.—Simultaneous tracings of the jugular and radial pulses. Note the well-marked respiratory effect upon the height of the radial wave. With inspiration there is a fall of blood-pressure and flattening of the radial curve. The rate is 235 per minute.

On May 17th at 4 P. M. the heart-rate was higher than at any time before, beating 246 times a minute (Fig. 85). At

5.30 P. M., exactly one and a half hours after that, the pulse-rate was found to be 106 a minute (Fig. 86). The phlebogram

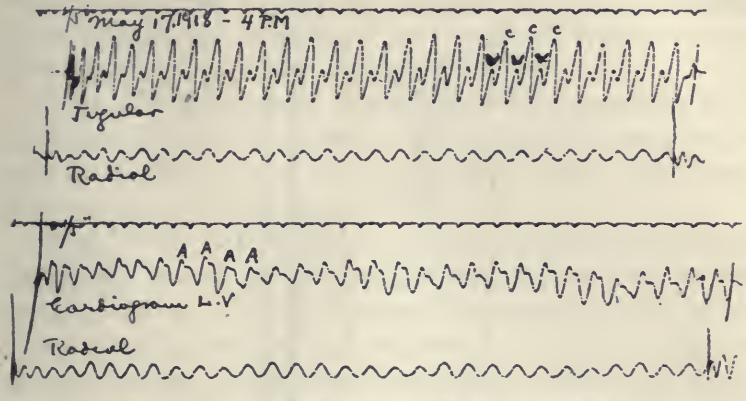

Fig. 85.—The rate has risen to 246 times per minute.

now shows the normal physiologic form, with normal *a-c-v.* sequence. The heart-apex curve is now triangular.

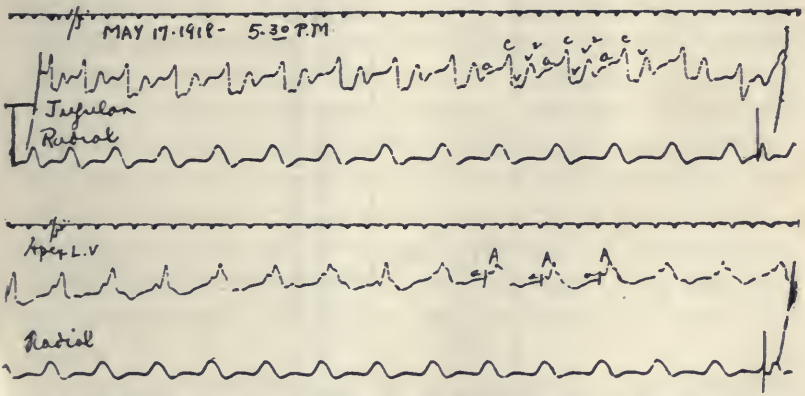

Fig. 86.—Simultaneous tracings of the jugular wave and cardiogram with the radial pulsation taken soon after the sudden cessation of the attack. Note also the change and variations in form of the cardiographic curve.

After several hours a marked respiratory arhythmia became evident. In the tracing (Fig. 87) the vagus slowing is shown plainly during inspiration. The average pulse-rate is now about 68 a minute.

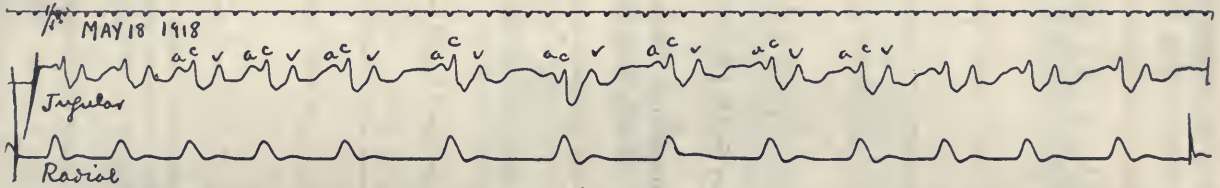

Fig. 87.—Marked respiratory sinus arhythmia. The effect upon the vagus is shown in the slowing during apnea. It is interesting that the vagus is influenced with such facility after the attack, and that it was so difficult to stimulate it during the attack.

Discussion.—From the point of view of the venous pulse alone, as has been shown by Peabody, all cases of paroxysmal tachycardia apparently fall into a group in which the venous pulse assumes the "ventricular" or "positive" type, and there is no evidence of any contraction of the auricles.

CASE II.—Paroxysmal tachycardia with diminished functional capacity between attacks. K. E. S., aged twenty-four, a recently enlisted soldier, was in the Base Hospital since April 11th for observation for heart disease.

Past History.—He had been a farmer for several years, doing moderately heavy work. He had measles, chicken-pox and mumps, and an attack of "grippe" some years before enlistment; no other illnesses nor operations. He gave a negative venereal history and had abstemious habits. His family history was negative.

Previous Attacks.—For six years he had moderate but constant shortness of breath, especially after exertion, and attacks of paroxysmal tachycardia. The first of these came on while he was milking a cow. He went to bed promptly and felt entirely recovered after several hours of rest. Attacks occurred at intervals of seven or eight weeks. During the year before enlistment they became more frequent, coming on at intervals of several days, and more often when the patient "felt exhausted." The attacks began very suddenly. Sometimes they were very short in duration, at other times they lasted as long as thirty-six hours. They always stopped suddenly. After the more lengthy attacks the precordial area remained tender and sore for several days. The patient had no hemoptysis, cough, or edema.

On May 15th the heart was not enlarged. The left border was $8\frac{1}{2}$ cm. from the median line and inside the nipple line. The right border percussed at the right sternal border and the apex-beat was in the fourth space. The sounds were normal. The temperature remained normal during the entire period of observation. The urinalysis was negative. The Wassermann test was negative for lues.

Present Attack.—On the evening of May 17th the patient was

returning from a short stroll on the hospital grounds when he began to feel short of breath. He lay down and the pulse remained normal in rate until two hours later. He then felt a peculiar "numb sensation" in the precordium and complained of a "fulness in the head." He had no pain and no palpitation or cough.

The pulse at this time was found to be very rapid and weak and could not be counted by palpation. Its rate was 220 a minute. Pressure on the eyeballs and both vagi had no effect upon the heart's action.

Twelve hours after the onset the outermost point of the apex-beat and the left border of the heart percussed 11 cm. from the midsternal line and at the nipple line. The upper border percussed at the third rib and the right border in the third space was $3\frac{1}{2}$ cm. to the right of the median line. There were no murmurs or accentuated sounds. There was no cyanosis and the liver was not enlarged.

About seventeen hours after the onset of the paroxysm the patient was moved with his bed to the *x*-ray laboratory for a radiogram. The tachycardia continued until the patient returned. He felt much better a few minutes later, and the pulse was immediately found to be slow and regular. Tracings taken soon after showed a pulse-rate of about 96, with no alternation, and normal a-c-v. sequence in the jugular tracing.

The patient was not cognizant of the change of rate, but he felt much better. The heart was still slightly enlarged over its normal size. The apex was in the fourth space and the left border percussed 9 cm. from the median line. The right border returned to the right sternal border. The systolic blood-pressure now was 104 mm. and the diastolic pressure was 54 mm. of mercury.

x-Ray examination was made before the end of the attack, with the patient lying on his back. Another examination, with the patient in the same position, was made two weeks later. This showed no difference in the width of the two cardiac shadows. In this case the end of the attack was attributed by the patient to the jarring and noise made in moving the bed through

the corridors. Perhaps the psychic stimulus in taking the radiogram cut short the attack.

The patient still continued to suffer with his previous cardiac symptoms. He had moderate dyspnea and palpitation, which were worse on exertion; constant tachycardia, moderately enlarged thyroid, and a moderate thyrotoxic tremor, but without eye signs.

Tests were made of the functional capacity of the circulation two weeks after the cessation of the attack described above. Table II presents the data at a glance. The patient was recommended for discharge from the military service.

TABLE II

	S.	D.	S.	D.	S.	D.
Pulse-rate, seated	120		120		108	
Pulse-rate, standing	144		138		126	
Blood-pressure, seated	110	70	107	70	110	75
Blood-pressure, standing	105	75	100	75	100	85
Exercise performed[1]	Hopping × 100		15 S. 46 × 5 ft.		15 × 57 × 5 ft.	
Foot-pounds of work	3750		3450		4275	
Pulse-rate immediately after	120		144		156	
Blood-pressure 30 seconds after	135	70	125	70	125	70
Blood-pressure 60 seconds after	128	68	130	80	115	75
Blood-pressure 90 seconds after	125	74	125	75	115	70
Blood-pressure 120 seconds after	120	70	116	75	112	75
Pulse-rate 2 minutes after	114		114		126	

Polygraphic Study.—Polygraphic tracings were taken four and a half hours after the onset of the attack. The pulse-rate was 220 per minute (Fig. 88). The form of the curve is that obtained in attacks of auricular origin. It shows the marked pulsus alternans so often found in paroxysmal tachycardia. This is due to disturbance of the function of contractility during the period of abnormal rate. The carotid or *c*-wave in the jugular tracing shows very plainly the alternans character of the beat. The phlebogram is of the ventricular form and shows no auricular wave. The cardiogram is triangular with inspiration and trapezoidal with expiration. This indicates the

[1] See note under Table I, page 433. This patient weighed 150 pounds.

dependence of its form upon the mechanical relations between the heart and the chest wall. In Fig. 89 the suggestion of an *a*-wave may be seen following the *v* at the foot of the *c*-wave.

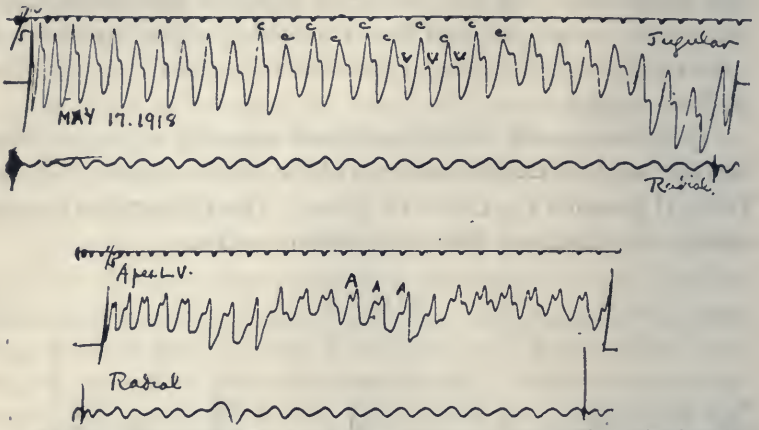

Fig. 88.—Simultaneous tracings of the jugular and radial pulsations and of the apex-beat of the left ventricle. Note the distinct pulsus alternans so marked in the radial and carotid waves. The cardiogram shows both the triangular and the trapezoidal form of curve, changing with respiration and relationship of heart to chest wall. The rate is 220 per minute.

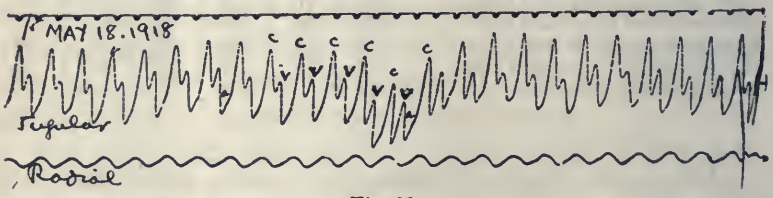

Fig. 89.

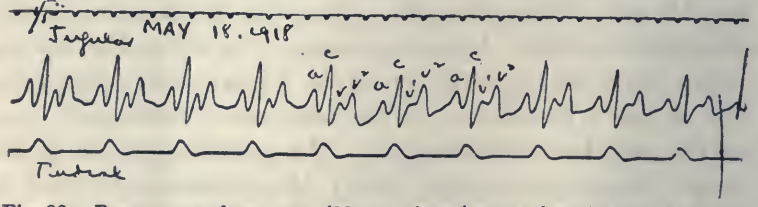

Fig. 90.—Return to a slower rate (90 per minute) soon after the attack ceased.

Figure 90 was taken soon after the termination of the attack. It shows the pulse-rate of 90 per minute, with no alternation, and the normal *a-c-v.* sequence in the jugular tracing.

CASE III.—Attacks of paroxysmal tachycardia; no cardiac dilatation after eight hours, as shown by *x*-ray; good functional capacity between attacks. Private L. G. B., aged twenty-two, was in active service as cook for nine months before he came under our observation in the Base Hospital, Camp Zachary Taylor.

Past History.—He was a student before his enlistment. He had chicken-pox and whooping-cough as a child. At the age of fourteen he suffered with subacute articular rheumatism during most of one winter, and since then frequent attacks of tonsillitis. Six months before his stay in the hospital he had a slight attack of sudden tachycardia, and soon after he had measles and mumps, with bilateral orchitis. His family history was negative and his habits good.

Previous Attacks.—His first attack occurred at the age of eighteen; but he did not recall the exact details of the incident. A second attack occurred perhaps six or eight months later, and recurred after half a year. Then the paroxysms became more frequent, the intervals varying from one week to six months. On the four days before admission to the hospital the patient had an attack each afternoon, lasting about ten minutes.

The attacks usually came on after being startled or excited, or after sudden or excessive exertion. They began suddenly, with a single "thump" in the precordium, after which the heart beat very rapidly and forcefully against the chest wall. Every little while, at ten- to thirty-minute intervals, the heart felt "cramped, as if by pressure of a hand around it." A sharp lancinating momentary pain darted through the chest below the left nipple. During the attacks the patient felt as if "buoyed up or floating on waves" as he lay in bed. They continued a varying length of time, and stopped suddenly, giving the same sensation "as when an elevator suddenly starts to descend."

Present Attack.—Until noon of July 3d the patient had been working as usual. While on his way to dinner he yawned deeply. Immediately the attack to be described began, with all the typical manifestations.

Physical Examination.—On admission the patient appeared to be in general good condition except for his natural pallor and nervousness. The palpebral fissure on the right side was wider than the left and the right pupil was dilated more than the left. There was no dyspnea or cyanosis.

The pulse was too fast to be counted accurately. It was regular, but inconstant in its volume. This is well shown in the

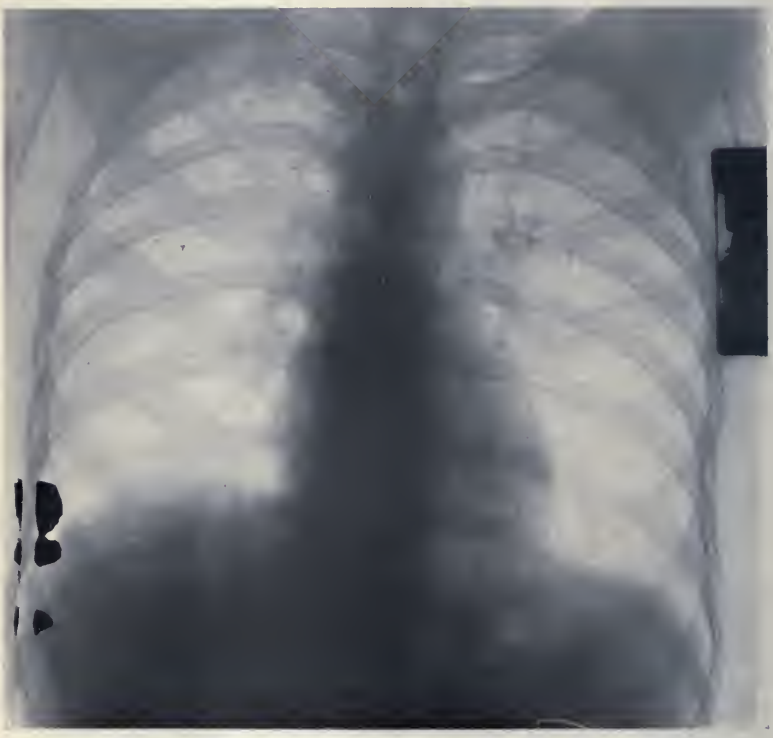

Fig. 91.

polygraphic tracings. The heart did not percuss enlarged. The apex was in the fifth space. Its left border was two fingers inside the nipple line and 75 cm. from the midsternal line in the fourth space. The right border percussed 2.5 cm. to the right of the midsternal line in the fourth space. The sounds were clear. The first and second sounds at the apex were of

equal intensity, and, with the rapid rate, simulated embryocardia. Prolonged pressure on the eyeballs did not affect the heart's action.

The lungs were clear and the liver and spleen were not enlarged. There was no edema of the extremities.

Course.—Polygraphic tracings showed a rate of 188 beats a minute.

Fig. 92.

The blood-pressure was taken with the patient lying flat in bed and the arm by his side. The systolic pressure was 69 mm. and the diastolic pressure was 49 mm. by the vertical mercury manometer scale. With inspiration the systolic pressure fell to 66 mm. of mercury, but the diastolic pressure remained unchanged. When the patient sat up in bed no sounds could be

elicited at the elbow to estimate the auscultatory blood-pressure with the arm in any position.

The respirations varied from 20 to 24 during the attack. The urinalysis and the Wassermann test were negative and the temperature was normal throughout. The entire clinical picture continued unchanged until 8.45 P. M., when the attack suddenly stopped, and the patient felt well. The area of cardiac dulness remained unchanged from before.

Radiographic examination of the heart was made about five hours after the onset of the attack, with the patient lying with his chest on the plate. The tube was $33\frac{1}{2}$ inches from the plate and centered exactly over the spine of the eighth dorsal vertebra (Fig. 91). Another examination was made twelve hours after the cessation of the attack, with the patient in the same position as before, and with the same relations of plate, tune, and time of exposure. There was little difference between the cardiac shadows, which corroborated the clinical impression in this case (Fig. 92).

The patient continued in good condition. After the attack the palpebral fissures and pupils were equal. After three days tests were made of the functional capacity of the circulation. The following data (Table III) evidence the normal functional capacity of the circulation in this case and indicate the height of blood-pressure between attacks:

TABLE III

	S.	D.	S.	D.
Pulse-rate, seated	72		78	
Pulse-rate, standing	84		108	
Blood-pressure, seated	104	50	114	72
Blood-pressure, standing	92	38	102	52
Exercise performed[1]	Hopping × 200		15 S. 76 × 5 ft.	
Foot-pounds of work	6000		5700	
Pulse-rate immediately after	144		136	
Blood-pressure 30 seconds after	136	50	122	70
Blood-pressure 60 seconds after	136	46	122	70
Blood-pressure 90 seconds after	134	52	122	70
Blood-pressure 120 seconds after	123	54	114	70
Pulse-rate 2 minutes after	90		108	

[1] See note under Table I, page 433. This patient weighed 120 pounds.

A month later the patient was seen at the end of an attack. The pulse was 208 per minute. The patient moved about considerably, but the pulse-rate remained unchanged. He lay down upon the bed with the examiner's hand over the precordium. As he touched the pillow the heart suddenly began to beat slowly and regularly and the patient instantly felt the change. He remained well during the subsequent period of observation, but was recommended for discharge from military service because of the frequency of his attacks.

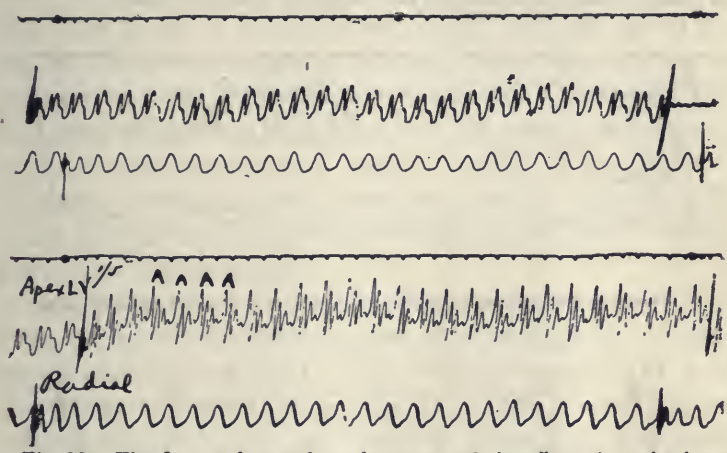

Fig. 93.—The figures show pulsus alternans and the effect of respiration on the height of the radial wave. The jugular tracings of the upper strip and the heart apex tracing of the lower strip are self-explanatory.

Polygraphic Study.—Polygraphic tracings taken four hours after the onset of the attack on July 3d show the *a-c-v.* sequence of waves in the phlebogram with a rate of 188 beats a minute (Fig. 93). The cardiogram presents a series of vibrations. The radial wave presents a slight degree of alternation and a distinct respiratory variation in height; that is, the waves are higher during expiration.

The attack suddenly stopped after eight hours of continual tachycardia. Polygraphic tracings taken soon after show the normal *a-c-v.* sequence in the venous curve with a rate of 68 a minute (Fig. 94). They also manifest a respiratory sinus

arhythmia and a slight fall of blood-pressure during the inspiratory phase.

Discussion.—The fall of arterial pressure is a constant finding in all these cases. The reason for this lies in the deficient filling of the ventricles during the very short diastolic periods. The period of ventricular systole is never much less than 0.2 of a second. If the rate is over 200 per minute, as it was in most of the attacks described, the period during which filling of the ventricles can take place is very short. As a result, venous auricular stasis occurs and the arterial pressure falls.

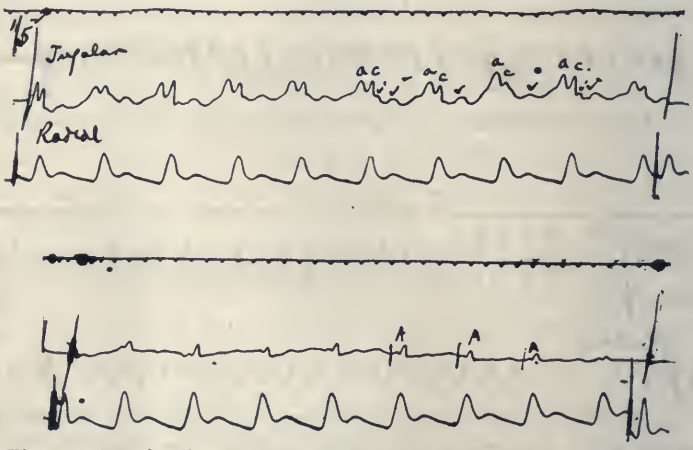

Fig. 94.—The jugular and heart apex curves are normal in the above figure, taken soon after the attack. The radial still shows the inspiratory drop of systolic blood-pressure.

The area of cardiac dulness may increase, as in Cases I and II, with continuation of the attack. Usually, however, the tonicity of the heart muscle is increased and the area of dulness is lessened or remains at least unchanged. The radiographs in Case III show this pointedly.

The latter case also illustrates the following distinguishing feature between paroxysmal and simple tachycardia. Lewis has shown that effort has no effect on the rate in paroxysmal tachycardia, while it increases the rate in other tachycardias.

Case IV.—Frequent attacks of paroxysmal tachycardia cut

short by pressure on the eyeballs. C. R. S., aged twenty-seven, was in Camp Zachary Taylor for nine months.

Past History.—He was a farmer for several years, doing, however, very light work. He had mumps, chicken-pox, and whooping-cough in childhood. He sustained severe injuries in a cyclone when he was eight years old. When sixteen he had pneumonia. He denied venereal infection and gave a negative family history. His habits were good.

Previous Attacks.—The patient remembered having had attacks of paroxysmal tachycardia since he was fourteen years old. The mode of onset was described "as if the heart stops still or is suddenly caught in a vise." This sensation was momentary and was immediately followed each time by the heart fluttering against the chest wall. At the same time there was tingling in the fingers and a feeling of aching and oppression in the chest. Sometimes the patient was dizzy at the onset. The patient stated insistently that everything in his sight took on a green color during the paroxysms.

The patient had no attacks for three years prior to enlistment in the army. Two months after entering the service a typical paroxysm occurred. After walking brusquely for a mile the patient suddenly felt warm and fell to the ground exhausted with the onset of an attack. After he rested for two hours the attack stopped as suddenly as it began. He later developed measles and pneumonia, from which he recovered without complications or cardiac manifestations. He felt, however, too weak for the regular drills after that. He was well for three months.

One night, while complacently seated, he fell to the floor, but did not lose consciousness. He felt as if a heavy weight had suddenly struck his chest, and when he tried to rise he could not support himself. He had no headache, cough, or vomiting, and felt well after the attack abated. He had several attacks before coming under our observation.

Present Attack.—He felt fairly well when first admitted to the Base Hospital on June 22d. One morning, after doing some light work in the ward, he had a sudden attack lasting three hours. He complained of feeling weak one afternoon. The

pulse was normal in rate. Suddenly it became rapid and uncountable for several seconds, and then resumed a slower rhythm. The polygraphic tracings were normal (Fig. 95).

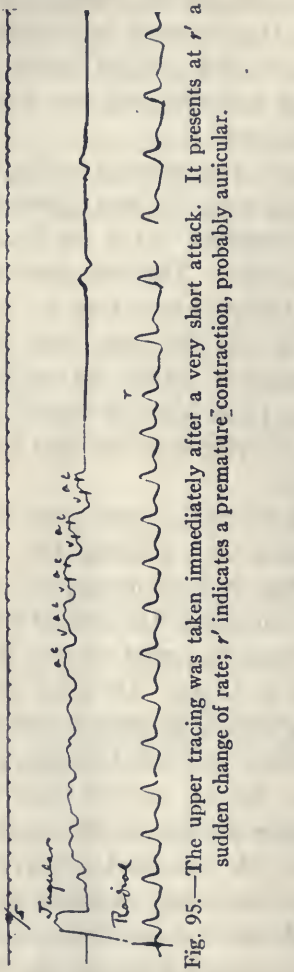

Fig. 95.—The upper tracing was taken immediately after a very short attack. It presents at *r'* a sudden change of rate; *r'* indicates a premature contraction, probably auricular.

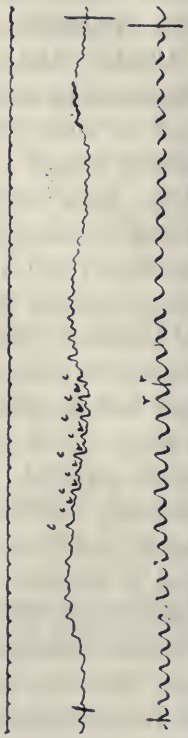

Fig. 96.—Hopping on one foot 30 times precipitated an attack. The tracing was taken immediately after the onset, and shows a rate of 222 beats a minute and marked pulsus alternans.

The patient was then instructed to hop on one foot. When he hopped 30 times he remained motionless, later describing a peculiar "numbness of his whole body," but did not turn pale. He was laid on the bed with a paroxysm of tachycardia and the tracings were continued (Fig. 96).

Continuous pressure was then made on the right eyeball for thirty seconds. The effect of this is apparent in the tracing and will be analyzed below (Fig. 98). The pulse-rate fell from 240 to 206 per minute. The moment when this change occurred is indicated in the figure by two or three waves showing exaggerated alternation. The pulse soon returned to 258 per minute. Pressure on both eyeballs was made for about two minutes and the attack stopped suddenly, having lasted fifteen minutes.

Another attack occurred five hours later. The patient felt suddenly dizzy and lay down in bed. This attack was also stopped after seventy minutes by pressure upon both eyeballs. Figure 100 shows graphically the sequence of events during this study.

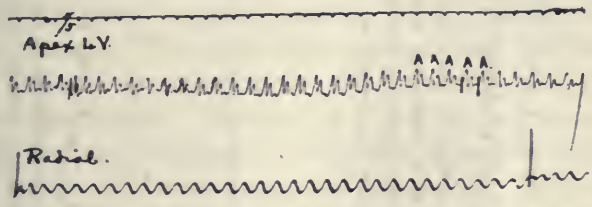

Fig. 97.—The apex curve is trapezoidal in form. It presents a series of three waves difficult of exact analysis.

There were no other data of clinical importance. Radiographic examination showed a normal heart shadow when the rate was normal. The patient was discharged from the hospital after a short period of observation and recommended for domestic service.

Polygraphic Study.—The analysis of the polygraphic curves in this case reveals a number of interesting features.

Figure 95 shows the first tracings obtained in this case. The upper strip was taken immediately after a short attack. Following the twelfth rapid normal beat a premature beat occurs at r'. The r-r intervals before this are about three-fifths of a second, the rate being about 100 per minute. The extrasystole initiates a slower rhythm in which the r-r interval is about four-fifths of a second, the rate being about 75 per minute. The pause following r' is equal to the interval between

each of the subsequent beats. The *a-c* interval is about one-fifth of a second, which is normal. The jugular tracing is, unfortunately, not complete, but there can be little doubt that we are dealing with an auricular extrasystole.

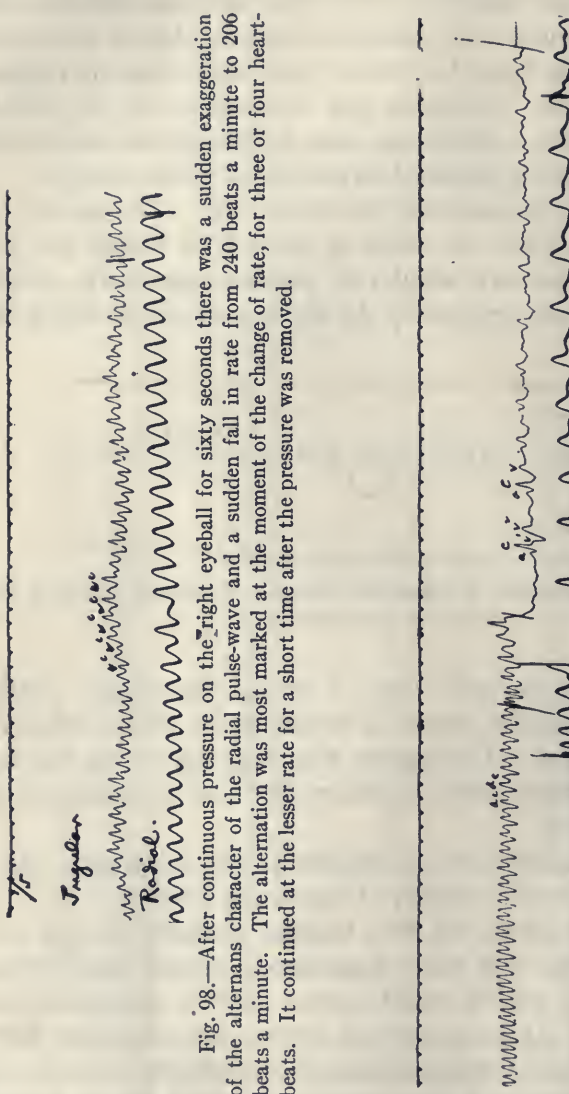

Fig. 98.—After continuous pressure on the right eyeball for sixty seconds there was a sudden exaggeration of the alternans character of the radial pulse-wave and a sudden fall in rate from 240 beats a minute to 206 beats a minute. The alternation was most marked at the moment of the change of rate, for three or four heart-beats. It continued at the lesser rate for a short time after the pressure was removed.

Fig. 99.—The pulse-rate soon returned to 258 a minute, as shown in the left portion of the tracing. Pressure on both eyeballs for 120 seconds stopped the attack suddenly, and the sinus promptly regained control. This is shown in right portion of the above tracing. The lower strip shows the sinus and respiratory arhythmia that so commonly follows the attack of paroxysmal tachycardia.

After the patient hopped 30 times a paroxysm commenced. This is shown in Figs. 96 and 97. The pulse-rate is 222 beats a minute, and it shows a distinct pulsus alternans. The phlebogram indicates the auricular origin of the paroxysm. The cardiogram is trapezoidal in form. It presents a series of three waves, difficult of exact analysis.

Continuous pressure was made upon the right eyeball for thirty seconds. The effect of this is shown in Figs. 98, 99. The pulse-rate fell from 240 to 206 beats a minute. The moment when this change occurred is indicated in the figure by two or three pulse-waves showing exaggeration of the alternans character. The pulse-rate soon returned to 258 beats a minute. Pressure was made on both eyeballs for about two minutes. The attack then stopped quickly, having lasted altogether fifteen minutes. The sinus soon regained control of the heart-beat. The polygraphic machine was interrupted inopportunely as the attack ceased. However, it is seen in the second part of Fig. 99 that the paroxysm terminates in a prolonged pause followed by resumption of normal *a-c-v* sequence. With regard to the prolongation of the first beat following the paroxysm, a slow sinus rate, with a gradual return to the normal as a sequence to a paroxysm, was a constant phenomenon in 2 cases observed by Lewis. In Laslett's case and in a case reported by Falconer and Duncan the first normal pulse period was prolonged.

Figure 100 shows the second attack with a rate of 210 beats per minute. It also shows marked alternation, and the period of the end of the attack. The rate after the attack stopped was 114 beats per minute. The attack was stopped by pressure on both eyeballs for about sixty seconds. No tracing was taken while the pressure was made.

Discussion.—Six cases of paroxysmal tachycardia in soldiers in France were recently reported by Hume. None of them showed endocardial lesions. The venous tracings from all of the cases had very similar characteristics; in each there were either one or two waves which fell in the period of ventricular systole, and in none could a separate "a" wave be detected, as evidence of auricular contraction. The polygraphic and elec-

trocardiographic studies made on these cases suggested that the attacks were of ventricular origin. This view was supported by the appearance of frequent extrasystole in one case during the non-paroxysmal periods. This finding contrasts with the usual infrequency of the ventricular type of paroxysmal tachycardia. In the majority of cases the abnormal site of origin of the paroxysm is in the auricle. Of 17 cases studied by Hart,

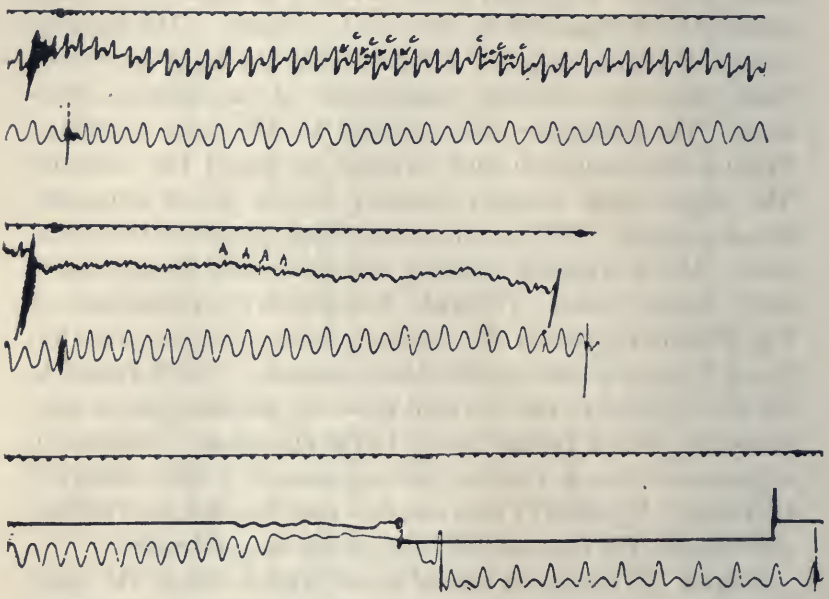

Fig. 100.—Polygraphic tracings showing marked alternation in the radial and the auricular character of the jugular wave. The rate is 210 a minute. The *a–c* interval is much reduced below normal. The apex curve is trapezoidal in form. The attack was cut short by continuous pressure upon both eyeballs for sixty seconds.

only 1 was of ventricular origin, and of 18 cases reported by Vaughn, only 2 were ventricular.

CASE V.—Attack of paroxysmal tachycardia due to auricular flutter; effect of the vagus upon heart action shown by the oculocardiac reflex; excellent functional capacity of the circulation after the attack. H. A. O., aged twenty-nine, was a physical director in Camp Zachary Taylor.

Past History.—He had measles, chicken-pox, whooping-cough, and mumps in childhood, and occasionally sore throat. He drank alcoholic beverages in moderate amounts until several years before coming to camp. His family history was negative and he denied venereal infection.

Previous Attacks.—The patient had attacks of cardiac disorder since he was fourteen years old. The first attack followed a strenuous bicycle ride. Palpitation lasted about a half hour, during which the patient rested. He was then able to resume his ride entirely recovered. He felt well until the time of onset of the war. He worked strenuously at his usual occupation.

In 1915, during a basketball game, he felt the tremulous movement of a rapid pulsation in the neck. He was not dyspneic or weak, but soon felt palpitation. After one hour this attack stopped suddenly. Six months later, while leading his class in an exhibition of physical training, another attack came on. This lasted about one hour and stopped during the continuation of the exercise.

About a year and a half later the patient had his severest attack. This followed strenuous gymnasium drill. The attack consisted of a "rapid pounding in the chest" and lasted eighteen hours. It stopped suddenly following the administration of aconite. The patient had no dyspnea or pain with any attack and never fainted. He was well again for two months and then had a short attack which occurred during physical exercise and lasted half an hour.

The attack for which the patient was admitted to the Base Hospital began during a game of volley ball at 7 A. M. on August 8th. The patient felt the sudden onset of palpitation and was admitted to the ward after two hours of comparative rest.

Physical Examination.—Throughout the attack the patient appeared in excellent general condition, with good color, normal temperature and respirations, and normal clinical laboratory analyses. The pulse was very irregular and rapid. The blood-pressure was taken with the patient lying flat on his back and his arm by his side. The systolic pressure was 104 mm. and the diastolic was 86 mm. of mercury by the vertical manometer reading.

The apex-beat was in the fifth space. The left cardiac border percussed at the outer margin of the left nipple in the third and fourth space 10 cm. from the midsternal line. The right border in the third space was 2 cm. to the right of the sternum. The upper border was at the upper border of the third rib. There were no murmurs. The basic sounds were weak. The heart action was apparently entirely irregular, with frequent extrasystoles. For short periods regular beats of greater rapidity seemed to occur. The physical examination was otherwise negative.

The patient felt generally well and was able to walk about with his usual alertness. After exertion the pulse-rate became only slightly more irregular, and the polygraphic tracings taken during the course of the attack are very interesting.

The attack subsided one-half hour after the last tracing was made and a few minutes after the administration of the first dose of tincture of digitalis—to which the patient naturally attributed his recovery. He felt a sudden change of rhythm, and a "thumping" in the precordium for a few seconds. The heart then beat normally. The attack lasted fifteen hours. Two days later showed normal capacity of circulation (see Table IV).

The patient was discharged well.

TABLE IV

	S.	D.	S.	D.
Pulse-rate, seated	96		84	
Pulse-rate, standing	120		108	
Blood-pressure, seated	112	66	104	74
Blood-pressure, standing	102	80	84	74
Exercise performed[1]	15 S. 6 ft. × 60		Hopping ×125×½ ft.	
Foot-pounds of work	5400		9125	
Pulse-rate immediately after	120		132	
Blood-pressure 30 seconds after	128	72	158	72
Blood-pressure 60 seconds after	122	72	156	74
Blood-pressure 90 seconds after	120	78	142	72
Blood-pressure 120 seconds after	122	78	140	68
Pulse-rate 2 minutes after	120		120	

[1] See note under Table I, page 433. This patient weighed 146 pounds.

Polygraphic Study.—Polygraphic tracings were made ten hours after the onset of the attack and repeatedly after that.

The tracings show an apparently absolute irregularity of the pulse. On closer study, however, the characteristic features of the auricular flutter are revealed. Except for the evidence given by the graphic curves, it would have been concluded that the case was one of paroxysmal tachycardia due to auricular fibrillation. Even despite the tracings with the rapid auricular rate it might be that the case is not one of flutter.

Figure 101 shows three strips from the jugular tracings taken ten hours after the beginning of the attack. The venous curve shows very distinctly the waves due to auricular contraction, marked *a-a-a*, etc., during ventricular diastole. In all the strips the same auricular rate is evidenced. In the third tracing, during ventricular diastole, the impulse due to auricular flutter was transmitted to the radial artery through the open mitral foramen and down through the aortic semilunar valves.

In this form of tachycardia the ventricle necessarily cannot respond to each auricular wave. It may respond to every second or third beat or quite irregularly. Regular beats may follow each other or may frequently recur; that is, the *r-r* intervals will have a certain time relationship to each other and also to the *a-a* period. This is well shown in all the tracings from this case during the attack. In Fig. 101 the equal radial pulses are indicated by similar markings in each separate strip underneath the radial curve. The marked *r-r* interval in the middle strip is equal to the sum of two of the * plus one *x* interval. Figure 102 shows a series of six equal beats in rapid succession at intervals corresponding to three auricular contractions. The rate of the pulse during this series is 125 and the auricular rate computed from this is 375 beats per minute.

Uniform digital pressure was made underneath the supraorbital ridge upon the left eyeball. This was begun simultaneously with the tracing indicated by the arrow in Fig. 103, and stopped at the point indicated by the arrow in Fig. 104. The figures are continuous. The total time of the ocular pressure lasted forty-seven seconds. The first effect of the pressure

upon the left eyeball is shown after twelve seconds, when the auriculoventricular block becomes longer than in any previous tracing. It equals at *r-r* an interval of about 12 auricular con-

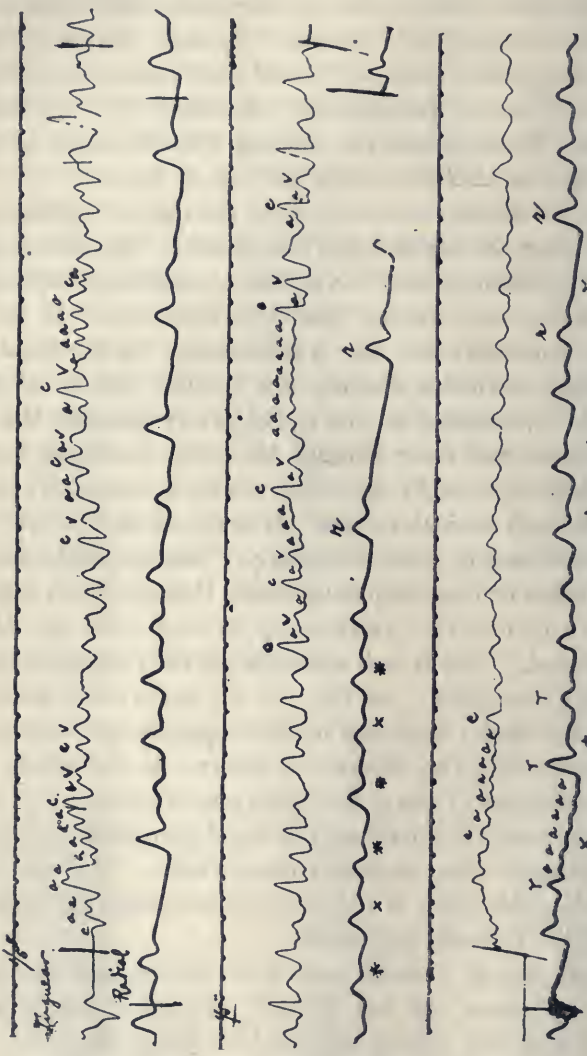

Fig. 101.

tractions. After eight seconds more the *a-v* block equals 1 to 14 auricular contractions at r^1-*r*. After four seconds more it equals about 1 to 20 at r^2-*r*, then 1 to 24 at r^3-*r* after one second.

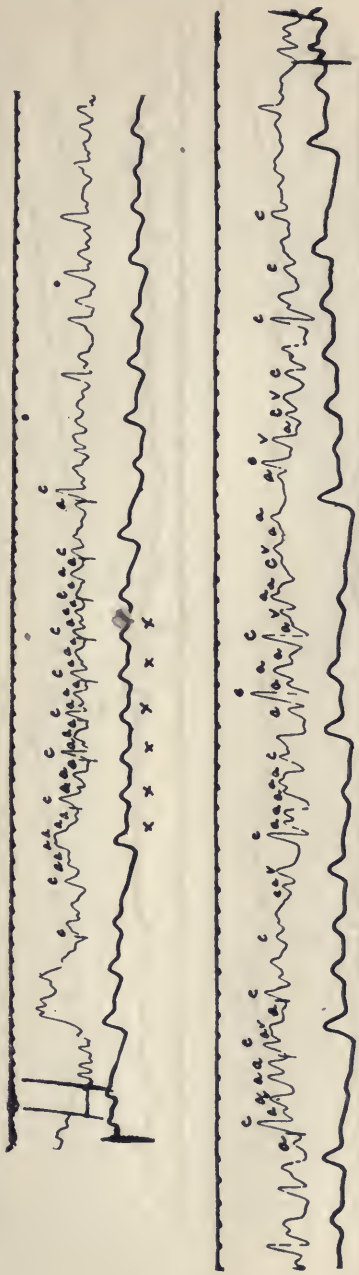

Fig. 102.

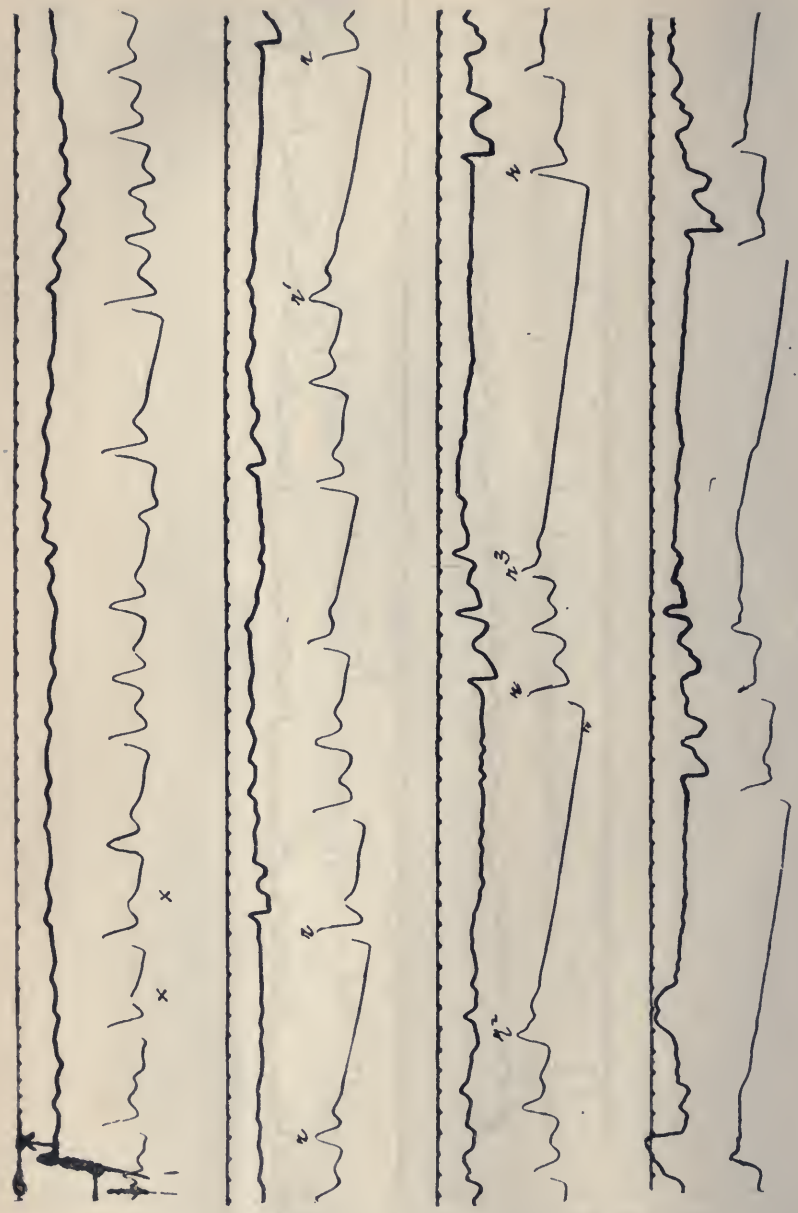

Fig. 103.

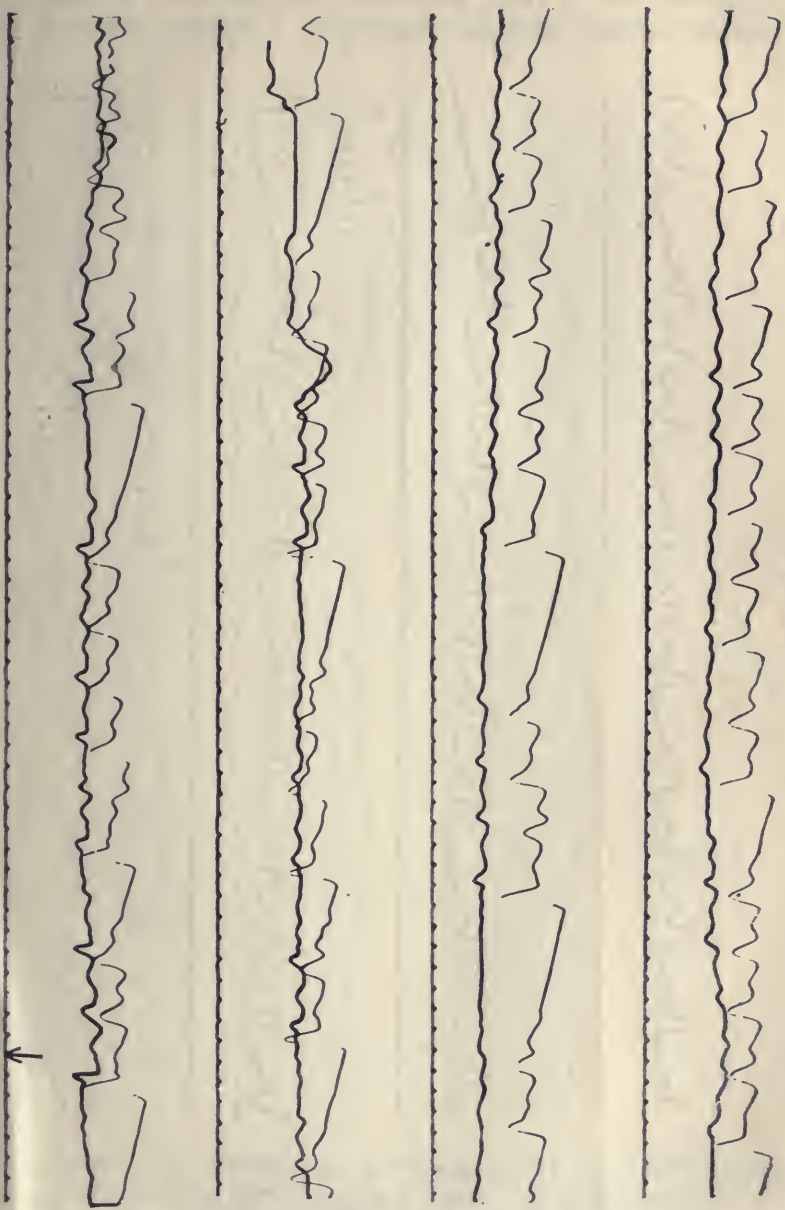

Fig. 104.

The evidence is clear, therefore, that the ocular pressure depresses auriculoventricular conductivity. Another feature is

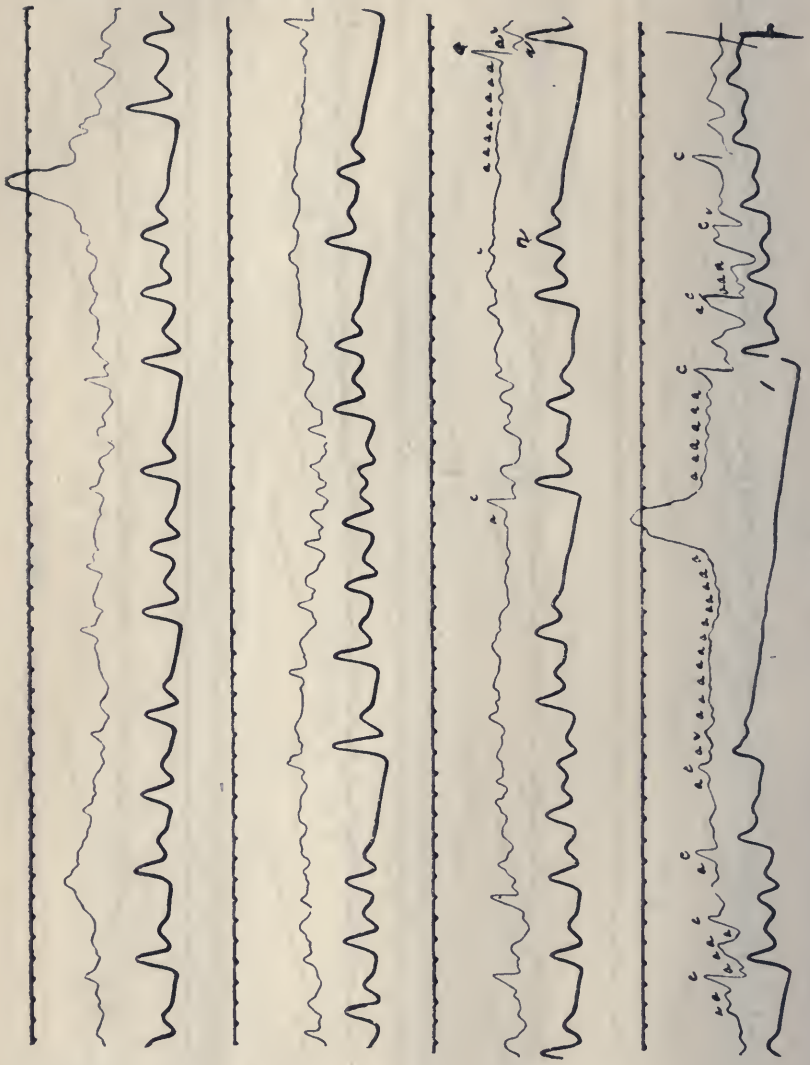

Fig. 105.

also to be noted. The depression of conductivity increases with the continuation of the ocular pressure. This is shown by the progressive reduction of the period between the periods of *a-v*.

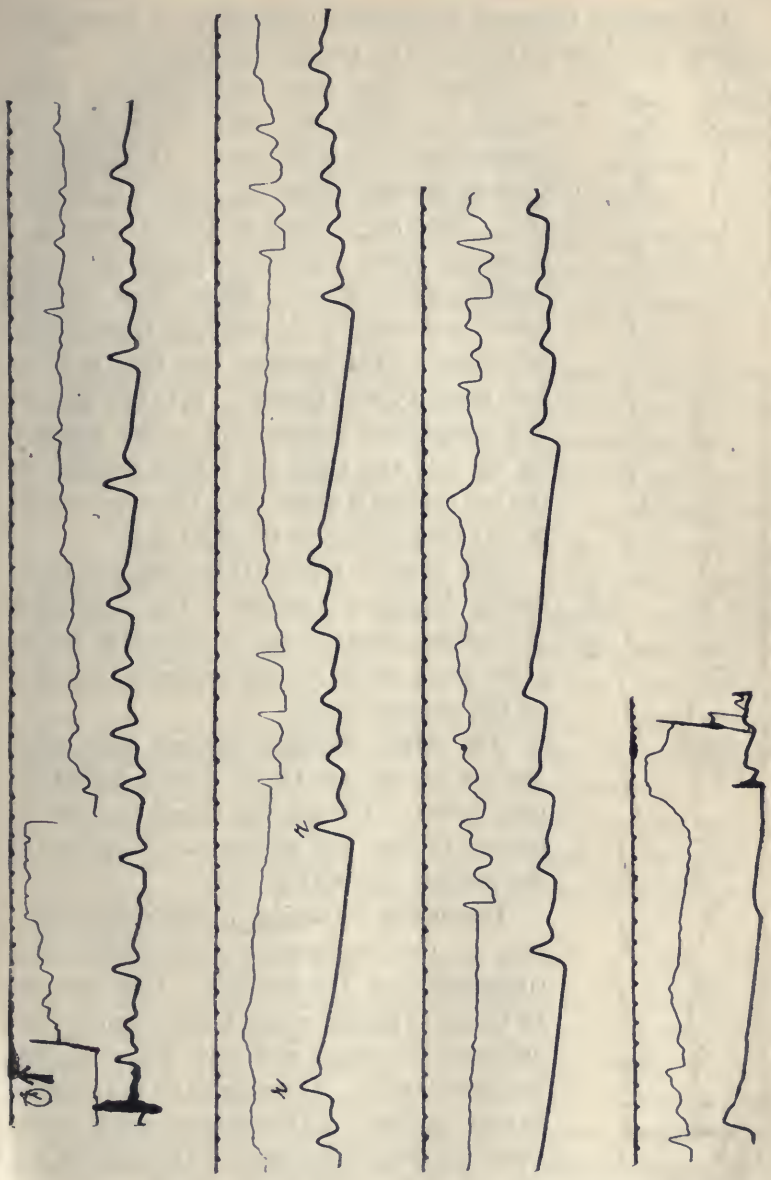

Fig. 106.

block. Upon removal of the pressure, recovery of conductivity in this case is shown to be very prompt (Fig. 104).

The auricles remained practically independent of vagus control and could not be inhibited by pressure on the eyes.

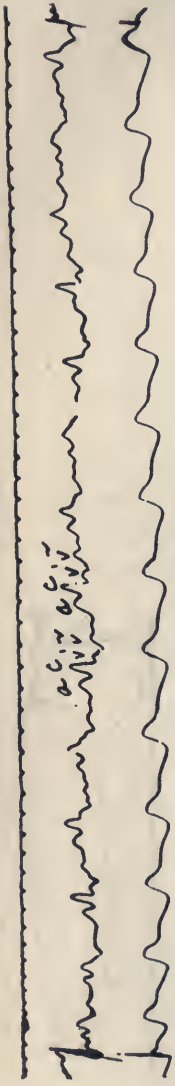

Fig. 107.

Pressure was then made upon the right eyeball to about the same degree as previously upon the other eye. It was begun thirteen seconds before the beginning of Fig. 105. The first evidence of any pressure oculocardiac effect occurs in about forty-one seconds, *i. e.*, at *r-r*. After three seconds more an interval of 24 auricular contractions is blocked. The pressure was then stopped and recovery was prompt. What is clear in this comparison between the ocular pressure on the left and right eye is that pressure on the left eyeball is about three times as prompt in its cardiac effect as the right eye.

Still another tracing (Fig. 106) was made during binocular pressure. The depression of cardiac conductivity is noticeable at *r-r* after seven seconds and progresses as long as the pressure lasts.

The attack subsided one-half hour after the last tracing was taken, having lasted fifteen hours. The tracing taken then shows normal rhythm and regular *a-c-v.* sequence in the jugular curves (Fig. 107).

Discussion.—Dagnini in 1908 called attention to the bradycardia that develops on compression of the eyeballs. This seems to be the most potent means at our command to influence the vagus, and thus indirectly control heart action. It produces all the changes in rate, rhythm, and conduction which follow vagus pressure in the neck. The path of the reflex is considered to be along the fifth cranial nerve, the medulla, and the vagus.

Liau first proposed to utilize this reflex as a means to arrest

paroxysmal tachycardia. Cohn and Fraser reported 2 cases, one of supraventricular or auricular origin and one of doubtful, possibly ventricular, origin, in which the effects of vagus compression were observed. The case of supraventricular tachycardia yielded easily to right vagus compression, but did not yield when the left vagus was employed. In the second case of doubtful, possibly ventricular, paroxysms, the attacks were stopped by left vagus pressure with great facility, and only with great difficulty by compression of the right vagus.

Robinson reports observations on 2 cases of paroxysmal tachycardia in which the rapid heart rate could not be influenced by vagus pressure. These are representative of those cases in which vagus pressure fails to abolish the tachycardia. The first 3 cases of our presentation belong to the same category. The cause of the ineffectiveness is not, however, any permanent derangement of the cardiovagal inhibitory mechanism, because, as in Case IV above, the heart-rate was slowed by vagus pressure, and, as in Robinson's case, increased by vagus paralysis with atropin. Robinson regards these cases as evidence that the influence of the vagus differs in degree on different parts of the heart, and that this difference probably depends on the anatomic distribution of both nerves.

Comment.—Cases of this type, in which the symptoms are periodic and paroxysmal in occurrence, usually pass undiscovered through the review given by the cardiovascular boards examining the troops.

In the examination made of troops by Feil, at Camp Dodge, by Smith, at Camp Custer, and by Butler, at Camp Mills, of a total number of about 85,000 soldiers, no case of paroxysmal tachycardia was encountered. In my own survey of about 27,000 recruits as a member of the board at this camp during the month of April, I was fortunate to observe 2 cases of paroxysmal tachycardia during an attack. The pulse-rate suddenly rose to 180 a minute in one patient soon after he entered, but the attack ceased by the time he was admitted to the Base Hospital. In the second case the pulse-rate was too fast to count

when the patient came in, and it was especially noted that the heart showed no murmurs. The following day, when the rate returned to normal, there were unmistakable signs of aortic regurgitation, on which account the patient was rejected from the army. This case illustrates the observation of Bard, that even the most pronounced of orificial murmurs are liable to disappear during an attack of paroxysmal tachycardia.

Usually, however, as in the series of cases here reported, the soldier is taken with an attack after a short period of military service and remains under observation in the hospital.

The medical literature, both French and English, especially during the last two years, presents a great deal of discussion of the war tachycardias.

Aubertin, in a recent study, emphasizes particularly the point that in most of these tachycardias, in which no lesion can be discovered in the heart, the patient is less adapted for military service than even with organic valvular lesions. This conclusion is also reached by Crouson and Mauger. They show that in a large number of these cases the tachycardias are caused by an infectious, organic, and latent heart lesion which may have antedated the war. According to them, these cases cannot be considered as merely functional. From a military viewpoint those cases, placed in a pathologic category, must be considered as having a lessened availability for war service.

Discussions and observations on this subject are also published by Dinet and Lewis and Pende. In the 6 cases of paroxysmal tachycardia reported by Hume, 3 of the soldiers had suffered from attacks before enlistment. In 4 of the cases attacks could be induced by slight exertion.

From the military standpoint, of course, the most important consideration is the determination of the serviceability of the soldier in the army, either at full duty or in a limited capacity; or whether the soldier should be rejected from military service. In general, the decision depends upon the proper and rational balancing of (1) the efficiency of the soldier and his value to the service, against (2) his ineffective days and his physical defects.

There are a number of important factors to be taken into consideration:

1. *The Frequency of Recurrence of the Attacks.*—A reliable history is of assistance in this connection. No statements of the soldier should, however, be accepted as proof of the disorder unless supported by objective evidence. If the soldier has had attacks often, entailing his frequent returning to the hospital, as in Cases II and III, reported above, he may be considered uesless to the service and even a burden upon it, and should be rejected. If the attacks are only occasional, as in Cases I and IV, in which two and three years respectively elapsed between paroxysms, the soldier is serviceable in the army. His work, however, should be limited to domestic and not overseas duty.

When the attacks are few and far between the heart does not seem to suffer. This is illustrated by those cases which showed a normal functional capacity in the intervals. But if the attacks grow longer and more frequent, the myocardium does suffer structurally as well as functionally.

2. *The Severity of the Attacks.*—Mild attacks, or those lasting only a few cycles of the heart-beat, may give very little symptoms beyond the uncomfortable precordium sensation. Severe attacks, lasting several days and with cardiac dilatation, deserve more liberal consideration when the question of serviceability arises.

3. *Valvular Defects that May Be Associated.*—These are to be dealt with, in general, according to the principles laid down in Circular No. 21 of the War Department. Definite organic valvular lesions in themselves exclude an individual from active military service. No special mention of paroxysmal tachycardia is made in the circular.

4. *Myocardial Defects.*—Paroxysmal tachycardia may imply myocardial damage. The electrocardiograph should be of great assistance in determining this point in any particular case, to review abnormalities in the shape of the P wave or of the Q-R-S complex, and to show defective conductivity in the bundle of His or its arborizations.

5. *The Cardiovascular Response to Exercise.*—This should be

obtained between attacks. Several different tests should be employed, and all findings should be co-ordinated before judgment is passed on the individual case. The delayed rise of blood-pressure after a measured amount of exercise is a fairly accurate measure of the cardiovascular response. We have just completed a study of the comparative value of a number of tests in estimating the functional capacity of the circulation in newly recruited soldiers, and we are analyzing and comparing the data for publication. Functional tests between attacks of paroxysmal tachycardia are of assistance in deciding whether a soldier is to be rejected or kept for domestic duty. It is to be noted that in Cases I, II, III, and V the functional capacity was excellent soon after the attack. There was no tachycardia. The pulse-rate varied little between the sitting and standing postures. There was no delayed rise of blood-pressure after 6000 foot-pounds of work. In Case IV, on the contrary, there was persistent tachycardia and instability of the pulse-rate blood-pressure, shown in the table, after 3450 foot-pounds of work.

SUMMARY

1. Five cases of paroxysmal tachycardia in soldiers are reported. The first 4 are of auricular origin, with typical polygraphic tracings. Case V is apparently due to auricular flutter.

2. The outstanding characteristic features are: The sudden onset of the attacks, the extreme tachycardia, the varied sensations associated with the heart's rapid action, the low systolic and diastolic blood-pressure, both during the attack and in the intervals, the marked respiratory variations of systolic pressure, and the sudden cessation of the attacks.

3. The polygraphic tracings are characteristic and assist in the diagnosis of the cases.

4. The importance and value of functional tests of the circulation are emphasized as being of decided help in the proper disposition of the cases.

5. Some of the more important factors are presented upon which to base the determination of the serviceability of the soldier suffering from this malady.

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POSTOPERATIVE PNEUMONIA

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In the effort to lower the incidence of pneumonia at Base Hospitals each of the various etiologic factors of the disease must be investigated. To the laboratory worker the most hopeful and certainly the most original avenues of attack are afforded, but in many directions clinicians may abolish harmful salients. One of these salients which can and should be almost eradicated is made up of postoperative pneumonia.

Postoperative pneumonia constitutes no mean share of the total pneumonia incidence at a Base Hospital. Between September, 1917, and August, 1918, 485 cases of pneumonia have occurred at Camp Devens, and among this number the postoperative cases amount to 30, or 6 per cent.

The incidence of postoperative pneumonia among 1423 patients operated upon has been 2.1 per cent. This may be compared with 2.2 per cent. reported by Whipple,[1] from the Presbyterian Hospital in New York, and with Risley's[2] figures, 1.5 per cent., for the Massachusetts General Hospital. They do not compare favorably with Krönlein's statistics, cited by Homans,[3] which show an incidence of 0.56 per cent. for 1409 operations.

Such comparisons are, however, unfair to the authors quoted, because they dealt with patients of all ages and classes in large general hospitals, whereas at a base hospital all are young and supposedly healthy.

The percentage of postoperative pneumonia in the total operations per month is given in the following table:

[1] Medical Record, 1916, vol. 89, page 581.
[2] Boston Med. and Surg. Jour., January 20, 1910.
[3] Johns Hopkins Bulletin, 1909, vol. 20, page 125.

Postoperative Pneumonia Arranged According to Months

Month.	Total operations.	Postoperative pneumonia.	Percentage.
October	81	2	2½
November	94	0	0
December	70	0	0
January	108	3	3
February	121	1	1
March	170	5	3
April	163	4	2½
May	206	4	2
June	216	5	2.3
July	157	5	3.1
August 1–12	37	0	0

Although writers generally have observed that the incidence of postoperative pneumonia corresponds with the incidence of pneumonia as a whole, and, therefore, is generally most frequent in February and March, this would not appear to have been the case in our small series. There would seem to be no relation between the incidence of pneumonia in these cases and the general incidence of pneumonia in the camp, the atmospheric conditions, or the time of year. All of these cases were subjected to a careful physical examination by the Ward Surgeon on the day before, and no impairment of respiratory tract discovered. In 3 of them, however, there had been a recent respiratory infection. One had just recovered from a mild attack of measles, another had been admitted to the hospital with an acute catarrhal pharyngitis six days before admission to surgical service, and one who had a cough with few râles in the chest was held under observation six days before operating. Although in all the physical signs were normal at the time of operation, it is certainly worthy of note that 10 per cent. of the series had had a definite history of condition predisposing to lung infection.

It is also significant that in cases in which one or more observations of respiration were recorded on the briefs, the number of respirations per minute is less than 19 and none over 20—in marked contrast to the cases admitted for pneumonia as compiled by Lieut. Gray of the medical service of this hospital, which show an average of over 24 respirations per

minute. It would seem unlikely, therefore, that there was any preliminary infection when the operation was undertaken.

The type of operation in the 30 cases who developed pneumonia was as follows: 1. Abdominal, 21 (hernia, 14; appendicitis, 7). 2. Genito-urinary, 2 (phimosis, 1; varicocele, 1). 3. Miscellaneous, 7 (hemorrhoids, 1; abscess of neck, 2; varicose veins of leg, 1; phimosis, hemorrhoids, and fissure of anus, 1; operation for hernia and varicose veins, 1; and one doubtful case after tonsillectomy).

It will be seen that 75 per cent. of the cases developed after abdominal operations, and that two-thirds of these, or approximately one-half of the total number of cases, are subsequent to operations for hernia. The large number of cases following abdominal operations is significant in that it conforms to the statistics of other authors. It is partly explained by the prolonged anesthesia. This would seem likely, because from out of a total of 504 otolaryngologic operations occurring during the same period at this Base Hospital, in the services of Major Knowles, M. C., there was but one case which developed postoperative pneumonia. Otolaryngologic operations consume, as a rule, but little time, patients are less deeply anesthetized, and recovery from the anesthetic is more prompt. On the other hand, it is surprising that the pathologic condition of the upper air-passages in throat operations does not counterbalance these advantages. The interference with respiration caused by operations upon the abdomen and the deeper anesthesia are also factors which help explain the preponderance of postoperative pneumonia in connection with laparotomies.

The method of anesthetization was ether by the open drop method with a preliminary subcutaneous injection of morphin and atropin one hour before the operation in 28 of the cases. One case was operated upon under cocain, and in one instance no anesthetic whatsoever was employed. The amount of ether averaged 220 gm. per patient, the limits being 90 and 320 gm. The duration of the period of administration of the ether averaged fifty-five minutes. The shortest etherization was eleven minutes and the longest three hours.

The same anesthetist administered ether to 8 of the cases; 7 anesthetists had 2 cases each, and the remaining 6 cases were etherized each by a different individual.

One surgeon operated upon 8 cases, another upon 4 cases, one upon 3 cases, two upon 2 cases, and the remaining 9 cases were operated upon each by a different surgeon.

The onset of the pneumonia in one-third of the cases apparently took place upon the same day as the operation. This conclusion was reached after a careful study of the temperature charts and the individual record. The average of the highest respirations observed within forty-eight hours of the onset was 27.4 Sixteen cases showed an onset on the day following operation, whereas the other 4 cases developed between the second and sixteenth days. The early development of the pneumonia is striking, and indicates the close relation to the operation. In this series of postoperative pneumonias the disease originated not as a result of stasis and gradual infection in an exhausted patient, but rather as a primary acute infection.

The diagnosis of pneumonia was made in a third of the cases the first day following the onset, in 7 cases two days after onset, and in 5 cases on the third day. One case was diagnosed on the fourth day, 2 on the fifth, 2 on the seventh, and 1 on the ninth. Only 1 case was diagnosed upon the day of onset. This suggests that it might be well for a clinician from the Medical Service to be attached to the Surgical Service as a liaison officer. His task would be not only to examine all surgical patients before operation but also to follow them up until the pneumonia danger is past. The position would certainly be an interesting one and could not but be of value. At present, though consultations are frequent, the medical officer from his transitory association with the case frequently fails to make a diagnosis as early as his surgical colleague.

The type of organism in half of the cases in which this was determined was Type 4; 3 cases proved to be Type 3, and four to be Type 2. Whipple found 77 per cent. of his series of cases to be Type 4.

The lobe of the lung affected in 13 of the cases was the lower

lobe on the right side, quite in conformity to the anatomic relation of the bronchus on that side. In 7 others the lower lobe on the left side was the one involved. Four cases showed disease of both the lower lobes and 2 presented an involvement of both the right upper and lower lobes, and 1 of both lobes on the left side. In the remaining case the upper right lobe alone was attacked. It is also noteworthy that 28 of the cases were lobar in type and only 2 were diagnosed as bronchopneumonia. This also corresponds to Whipple's findings and differs from what the earlier literature would lead us to expect. Perhaps this is to be explained by the more frequent use of the *x*-ray as a means of diagnosis both in his series and ours.

Leukocytosis was usually present and averaged 15,000. In one case, however, the number of white blood-corpuscles was reported to be 4300.

Complications occurred in 12 cases. In 8 this took the form of pleurisy. One case developed phlebitis of the left leg, 1 a severe pharyngitis, 1 a furuncle on the left side of the face, and in another a subphrenic abscess appeared probable.

The outcome of the 30 cases was strikingly favorable. It compares well with Graves,[1] statistics, which are based upon a series of cases largely non-suppurative, and, as to be expected, is distinctly better than the figures of large hospitals founded upon a mixed series of cases. The reason for this appears to be, first, that none of the operations were septic in type, and, second, that in none were the patients weakened by disease. Twenty-one cases, or 70 per cent., were discharged well, 5 cases as improved, while 1 case remains unimproved, though the lungs are normal. He has been recommended for discharge from the army on account of phlebitis. One patient is still convalescent. Two cases died, one on the sixth day after the onset of the pneumonia, and the other sixteen days from the onset. The autopsy in these 2 cases revealed the following conditions: One case showed the pneumonia of the upper and lower lobes on the right side, an acute, fibrinous pleurisy on the left side, emphysema and edema of the lungs and fatty infiltra-

[1] Boston Med. and Surg. Jour., 1910, vol. 163, p. 497.

tion, and passive congestion of the liver. The second case presented complete pneumonia of the right chest, acute purulent pericarditis, as well as an acute right serofibrinous pleurisy. The upper right lobe also contained an abscess. There was an acute splenic tumor. The right kidney showed hydronephrosis and there was a double diverticulum of the right ureter.

The striking feature in these cases would seem to be the incidence of pneumonia in perfectly healthy adults after simple uncomplicated operations. The case in which it followed cocain anesthesia and one in which no anesthetic at all was used must be regarded as accidents. They were cases of simple cervical abscess in which the operation of incision and drainage was too insignificant to have been of influence in causing or modifying the subsequent pneumonia. In the remaining 28 cases in which ether was administered the anesthetic was from three different manufacturing chemists, so that its make was not a causative factor.

That the percentage of cases developing pneumonia ran very evenly through the different months as compared to the general incidence of pneumonia, that none of the cases presented before operation any physical signs of lung infection, and that the pneumonia developed with different makes of ether given by different anesthetists, makes it fairly clear that its incidence is not the result of the general prevalence of pneumonia, of an impending or potential pneumonia present at time of operation, or of the kind of ether or the presence of an infection in the etherizer. The factors that are common to all the cases are increased secretions of mouth and throat and upper air-passages, deep breathing, and an absence of laryngeal as well as bronchial reflexes. Our mouths and throats are always carriers of infectious organisms. Even with the most careful etherization the possibility of inhaling the secretions from the throat and upper air-passages is always present. In difficult anesthesias and without specially trained and experienced anesthetists the chances of such an accident constitute a real danger. Our observation would seem to us to indicate that these postoperative are really inhalation pneumonias and that the administration of the an-

esthetic, the exposure of the patient to cold and wet during the operation, and his care until full consciousness is restored, are the important factors to be considered in studying the means of prevention. Preventive methods should accomplish much against this type of pneumonia, and Army Hospitals afford a splendid opportunity to put them in force. Organization of both the medical and surgical services and hearty and close co-operation between the two with this end in view should yield results. As previoulsy mentioned, a member of the medical service might profitably be asked to examine the respiratory tract carefully before the operation.

In addition, the following measures should be put in force:

1. Patients with respiratory infections, irrespective of their severity, should be excluded from the pre-operative ward.

2. Hygiene of the upper respiratory passages should be insisted on as a preliminary to the operation.

3. The anesthetist should be selected with the greatest care, and under no circumstances should an untrained individual administer ether without the closest supervision. Means should be taken to make the position of anesthetist one of honor.

4. The duration of the narcosis should be as short as possible; the exposure of the patient should be minimized; under no circumstances should he be allowed to lie in wet surroundings. Efficient organization can here be developed to a high degree.

5. As soon as the progress of the operation will permit the patient should be placed on his side to favor the drainage of throat and mouth secretions, and this position should be maintained until full consciousness is restored.

6. On return to the ward the patient should be placed in warm blankets and should be watched by a special nurse until fully recovered from the effect of the anesthetic.

Postoperative pneumonia is a controllable disease. For its prevention and control close co-operation is needed between the surgical and medical service. It is the medical opportunity par excellence for a liaison officer.

NEUROCIRCULATORY ASTHENIA

EPIDEMIC PAROTITIS AS A MILITARY DISEASE

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July, 1918.

NEUROCIRCULATORY ASTHENIA

There are few if any of us who can fully comprehend how completely the war has altered all aspects of life in America. As we go on we become more and more convinced that the extent and degree to which the great war must change even the minor details of our life are but beginning to be realized. These modifications have been no less in medicine than in the manufacture of military as compared to sporting arms, and the constant wonder of those of us who have gone into the army hospitals from large civilian institutions has been the very different picture which the military type of a disease presents as compared to that with which we have been accustomed even in the largest of our civil hospitals.

I venture to say that two years ago few physicians, no matter how well read or how thoroughly conversant with their profession, would have recognized what the term "neurocirculatory asthenia" is meant to confer. Yet the disease has been long known in this country, dating back to the Civil War, when Da Costa described precisely the conditions which we are to discuss under the very apt caption of the "Irritable Heart of the Soldier." Our English colleagues who, unhappily for all of us, have been longer versed in the military medicine of this war denominate the syndrome, for it is really a collection of symptoms rather than a definite disease entity, as "D. A. H.," which stands for disordered action of the heart. I find that Russian Army surgeons have long been familiar with

the condition, and it is very probable that we also should have remembered Da Costa's excellent description of the condition had we, as Russia, kept a standing army; but had we been thus forehanded it is very improbable that we should be at this time wearing a uniform and engaged in the most desperate combat of all history.

We may briefly define neurocirculatory asthenia, which is the official term adopted by the Surgeon-General, as a complex of symptoms occurring with great frequency in males of the military age, characterized by neurocirculatory instability, chiefly manifested by marked emotionalism, cyanosed hands and feet, dermographia and tachycardia, by tremor, and by attacks of asthenia, which simulate in aggravated instances epileptic attacks. More than anything else the cases resemble instances of hyperthyroidism which we see so frequently in young women. Indeed, many instances of neurocirculatory asthenia resemble exophthalmic goiter even to the extent of presenting, in addition to the other signs and symptoms, definite goiter and exophthalmus. We shall discuss later the probable relationship between these two conditions.

There are two distinct types of persons affected by this curious war disease, the one and the rather more numerous class is composed of young men of a high grade of intelligence, but of an intensely emotional temperament. The other class is composed of young men of a low grade of mentality; they are usually uneducated and incapable of acquiring knowledge and skill or anything, but none the less they are, like the other class, intensely emotional, neurasthenic, and not in the least stolid.

Why is it that we have all of a sudden become aware of the high degree of prevalence of this condition? There are several reasons. Many of these persons are quite able to grapple with the problems of ordinary civil life with its but moderate emotional strain and stress, though of an unstable nervous temperament. They have passed among their associates and friends, and even to their physician they have seemed but rather more than ordinarily temperamental. The nervous strain of war conditions, the breaking of home ties, the fear and anxiety of it all, and

finally, in many cases the emotional strain of the parting, perhaps associated more or less with excesses of an alcoholic and sexual character, have intensified the symptoms and rendered the condition apparent as a disease manifestation. More, however, than all of these factors combined has doubtless been the fact that in the course of the searching physical examination of the draft men we have found conditions which might pass without special comment in ordinary civil life. The great question for us to solve is: Are these men able to take up the vocation of a soldier, are they a credit or a debit to the military strength of the country? It is from this standpoint that I wish to discuss the subject. The disease is very common, more frequent than all other forms of circulatory diseases put together, as we meet them on recruiting boards.

One of the very first points which the recruiting officer will note in regard to these cases is the very strong influence which race plays in its incidence. The Jewish race includes fully two-thirds of the cases which present themselves, and of these, the greater number are among the Russian Jews. Next in point of frequency stand the Italians, then the Irish, the Americans, the Scandinavians, and last of all the negro.

As we have seen it, it is not common among the French, nor relatively so among the British. So very infrequent is the condition among the colored troops that I still seriously question the diagnosis in the three or four possible instances which I have observed in the very considerable number of colored men (nearly one division) which I have seen at Camp Upton.

Another very striking feature of the condition which we have all noted in our troops and draft men at Upton has been the very definite relation which heredity bears in neurocirculatory asthenia or "N. C. A.," as we shall call the condition. In by far the greater number of cases the taint has been transmitted from the maternal side, though by no means infrequently both parents, especially among the Russian Jews, have presented perfectly clear stigmata of the condition. In most cases these have been definite instances of hyperthyroidism, Graves' disease, or perhaps of myxedema, very frequently "epilepsy," neurasthenia,

and almost without exception some form of nervous or emotional instability. Major Goddard and Lieutenant Goldcamp have noted the very high degree of frequency with which parental or personal rachitis is associated in the disease. I have wondered sometimes if this may not be in part due to the fact that the condition is very frequent among the Italians, who are also very prone to rickets.

The early personal history of these cases is of very great importance and of great constancy in these cases. In nearly all instances men afflicted with N. C. A. give a history of unsound and sickly infancy, of the great care which was necessary in order to rear them. Their early juvenile life has also been with few exceptions marked by all the ordinary and at least some of the extraordinary childhood illnesses and by frequent gastro-intestinal and metabolic disturbances.

Few of them give a history of normal boyish physical exploits, and inquiry as to their sports almost always elicits some such answer as "I was not able to play baseball or football," "I was so poor at the games that the boys would not have me play with them," etc. On the contrary, some of those of the intelligent class tell you that in youth they preferred to read, study, or some other sport not requiring physical effort; some of them early became interested in music or art to such a degree that they did not care for outdoor sports. Still others make the statement that though they were fond of boyish games and sports, they had little opportunity to indulge in them because of shortness of breath, of palpitation of the heart, etc., when they tried to play. Almost without exception they give thus the story of early physical inefficiency.

Many of them state that the society of other boys was not agreeable to them, that they preferred to be by themselves, etc., "boys were too rough." In families one finds, as a rule, that the boys who develop this disorder selected the company of their sisters in preference to that of their brothers in their early years, and, as a rule, their pleasures and recreations of election were such as would entertain girls rather than boys.

Notwithstanding this apparent preference for female society,

it is really astonishing to find how almost constantly these cases make the statement that the female sex has had little or no attraction for them, and by far over 50 per cent. of them have never experienced sex life with a female. Some state frankly that this has been because it has offered no attractions to them, others place their abstinence on moral grounds, others on inability, but most of all on disinclination. A few state that their experience in this direction was so unsatisfactory that it was not considered worth the effort, or that it caused them to feel worse, etc. It is believed that a certain considerable number are more or less perverted, but a majority are simply neutrals on sex matters.

In the choice of occupation a very similar tendency is shown. Few of these boys have elected occupations of an active character. Most of them have been clerks, accountants, students, writers, musicians, artists, and the like. A very few have attempted for a time such occupations as machinist, artisan, etc., but most state frankly that they found themselves inadequate for the work, that they either lost their jobs or threw them up for something of a more pacific character. A good many make the statement that their doctor forbade heavy work or exercise, and insisted on their selection of indoor or clerical work.

Nearly all of them give an extremely kaleidoscopic history of medical attendance and of diagnoses; in the larger number of instances they have been early told that they were suffering from "heart disease" and their instructions have been based on this assumption.

Most cases show a very poor physical development. The chest is narrow, the respiratory excursion constricted and limited, and as Goddard and Goldcamp have noted, a considerable number do show rachitic-like deformities of the chest. As a rule the muscular development is poor, the muscle tissue flabby and immature. The beard growth is small, some show small or undescended testes, small penis, and a distribution of hair like that of the female type. This is, however, by no means constant; some of these subjects are perfect in these particulars, but the type as a whole is definitely and decidedly defective.

I fancy that they are deficient in gonads as Barker would express it, they lack "pep" in the words of the top sergeant.

The emotional and nervous status is the most striking feature of these cases. They are overly emotional, temperamental, imaginative; many of them are sent to the department of neurology and psychiatry instead of to the medical service. They weep, have hysterics, imitate most perfectly epileptic seizures, and otherwise act in a most artistic manner. Many of them are frightened to a pitiable degree at their induction into the army, and the prospect of actual combat terrorizes them almost beyond control. On the other hand, there are those of them who have sought the service with most elevated ideals of self-sacrifice, who earnestly desire to imperil their lives and to offer them for their ideals. Some of these men are of the highest possible type from the standpoint of an idealist, almost too much so for real life, yet of such stuff are heroes made. On the contrary, others desert, beg for discharge, for exemption, for transfer to non-combatant corps, and all apparently with no sense of shame.

To one accustomed to these cases, as, for example, the recruiting officer soon learns to be, they may be picked out of the line almost unerringly, so clear-cut and definite is the clinical picture of the conditions. Some recruits especially when in terror or when perturbed, as during their physical examination, present the picture of a typical exophthalmic goiter. Exophthalmus with Von Grafe's and Stellwag's signs is present. The expression of the face is one of emotional distress and anxiety, goiter is definitely present; it may be bilateral, monolateral, or of the isthmus alone, and it, together with the exophthalmos, varies from time to time, always becoming more marked when under stress.

Tremor, especially marked in the hands, also present in the tongue, is a constant sign of the disease; it varies greatly in its intensity, but is always intensified by emotional disturbance. Curious to note, though the patients themselves note and complain of this symptom, few have found it to interfere with their occupation, as, for example, that of violinist, watchmaker, etc.;

in other words, under mental states the tremor is a controllable symptom to at least some degree.

The evidences of neurocirculatory instability are numerous, the hands and feet are cyanosed, cold, and the palmar surface of the hands and axilla stream with sweat, even though the examining room be cold. Dermographia is very marked in nearly all instances, though it is a symptom again which varies much in degree, but is always intensified by emotional stress. Throbbing carotids, brachials, and so marked a throbbing of the abdominal aortas are occasionally seen that cases have been sent to my service under the diagnosis of abdominal aneurysm. One of these cases was in a very capable young physician who had himself confirmed the diagnosis, from which he was dissuaded with considerable difficulty.

But of all the signs and symptoms, that which is most constantly complained of and which serves to classify the cases is that of tachycardia. The heart rate may vary from 88 to 200 or even more, the action is tumultuous, and in a large number of cases where action is not so rapid as to completely prevent analysis a soft systolic murmur is frequently found, almost constant at the apex, but it varies much in intensity, quality, occurrence, and at times it entirely disappears. The murmur is not characteristically transmitted; it is certainly not due to any organic lesion, but a large number of these cases are diagnosed as instances of myocarditis, and still more often as mitral incompetence. In most cases there is no cardiac hypertrophy; this is a most important point to determine in the differentiation of these cases, for we shall find that in true N. C. A. moderate exercise, especially if administered under congenial conditions, *slows the heart*, and if persistently and intelligently so applied, permanent slowing may follow. Most of the cases complain of more or less cardiac distress, of a sense of precordial pressure, of a bursting pain behind the sternum, sometimes of lancinating pains reflected into the axilla, etc. The description is commonly not very consistent or coherent, but they all complain of some sort of symptoms in this region. Head zones of cardiac hyperesthesia are, however, not ordinarily present, and careful

study of the heart under varying loads by the fluoroscope and polygraph show no evidences of organic cardiac disease. In the latter stages, just as in true exophthalmic goiter, of course finally cardiac disease does develop, but it is commonly not evident during the military ages, but only long after.

Dyspnea is present almost invariably; it is definitely excited more by mental rather than physical conditions, and while in carefully graduated cases dyspnea diminishes much, it can be easily aroused by mental stimulation. One of our cases would develop dyspnea of the most distressing degree if told that he was a slacker trying to evade service. Some other cases, however, fail to object to this remark. It is true that in most cases the chest is poorly developed and that the aëration of the blood is habitually defective in most of these cases. But it is also quite certain that be this as it may, there is no connection between the anatomy of the lung and this frequent sign of dyspnea.

The asthenic attacks are, however, among the most interesting and difficult of explanation. Some cases show them only in a very mild degree and others in a very marked grade. Some attacks are clearly of a hysteric type; they may be excited by fright, temper, and sometimes I think that they may be conjured up by the earnest desire of a peacefully inclined slacker. In other instances they are convulsive in nature like an attack of epilepsy, the tongue may be bitten in the paroxysm, and the patient may lie for hours thereafter in a comatose state. The attacks are very likely to appear in the course of an unaccustomed hike, especially with the recruit who becomes convinced that he is asked to do more than he is liable or able to perform. Other patients tell me that these attacks have come on entirely without warning, and the patient was only aware of the syncope when he awakened in the hospital. I do not believe that many of these attacks can be distinguished from true epileptic paroxysms in single instances, and the absolute differentiation implies often a long and discerning study of a case. Occasionally in place of a convulsive paroxysm the patient flies into an ungovernable and incoherent attack of temper, during which he

is really irresponsible, or he may weep and carry on like a hysteric young lady. Although many of these attacks are brought on during physical exercise and particularly during unaccustomedly heavy drill, it is notable that the most frequent exciting cause has an emotional basis. I recall one instance in which a sharp word of reproval from a general to a recruit who had failed to salute him properly caused the poor chap to fall in a convulsion at the very feet of majesty, who was then almost as much perturbed as the poor soldier himself.

Where these cases may be placed under careful and skilled medical care, and especially when the young soldier becomes more accustomed and reconciled to his new life, it is notable that in nearly all cases improvement occurs. In one class of cases, however, this is not the case—that is, in those which are definite instances of exophthalmic goiter; these I believe without exception fail to show improvement even though they may become more adjusted to their environment.

One can hardly see these cases and not feel at the very outset that in some way they are dependent on some lack or irregular or deficient action of the chromaffin system, particularly of the adrenals or thyroid. Close study has, however, convinced me that it is not by any means purely a question of hyperthyroidism, though I am also convinced that hyperthyroidism plays an important rôle in the syndrome. The administration of thyroid to these cases accentuates beyond any doubt the symptoms; similarly, the giving of adrenalin intensifies the symptoms. Blood-pressure in the disease is almost always low and the pulse-pressure notably so, yet the subcutaneous administration of adrenalin fails to raise it. We shall presently return to this phase of the question, however, in the discussion of the etiology.

Tobacco intensifies the symptoms, especially if used in excess. Most patients fully recognize this fact, and frankly state that they are so much worse when they use tobacco, especially liberally, that they find themselves obliged to give it up entirely. Few of these patients use tobacco where the condition is fully developed. The same is true of alcohol. The patients soon

find that they cannot tolerate alcohol with comfort, and the effects are soon such that they develop a distaste for all forms of alcohol. For the same reason few of these recruits are devoted to the theater or to the reading of detective stories; they have found that all emotional stimulants cause an exaggeration of their symptoms and an increase of their discomfort.

As I have described this syndrome to you, it must be evident that I am picturing to you a hereditary condition to a greater or lesser degree, a picture which is dependent in very large part at least on very early defects in the emotional mechanism of a man and evident in his very early youth. The full-bloom complex is developed by emotional excitement incident to his draft, his separation from home, and the new and rather terrifying occupation and life into which he is suddenly projected, often more or less unwillingly. Our question is, Can we make soldiers of this material? And second, If not full line duty soldiers, then can we still utilize them for semimilitary purposes in clerkships, in factories, or on farms? This is the N. C. A. which we see in the concentration camp and in the training-school, for this is a very frequent condition in the training-schools for young officers particularly. The British report a condition with a similar clinical cast, but which develops under condition of actual service and especially in troops after protracted trench duty. Lewis, Mackenzie, and others connected with the great cardiac hospitals in Great Britain picture this condition as developing as a result of hard service, and show, of course, its very intimate relationship to that still more indefinite war-medical problem—shell shock. Fully 20 per cent. of such cases under appropriate treatment are able to be returned to full line duty. This has not been our good fortune, and Rothschild, of Mt. Sinai Hospital, who with Oppenheimer has made an extensive study of this condition in the British hospitals, confirms our suspicion that the cases which occur under service stress are a quite different and altogether a more promising problem than those which develop under the lesser stress such as we have studied in the mobilization and training camps, where none the less the condition has been astoundingly

frequent—certainly thousands of cases have been observed in our camp at Upton alone.

To return now to the etiology. I do not believe that anyone can study these cases, at least those which have fallen to my service, without being at first strongly of the opinion that the condition is purely one of hyperthyroidism. There is no sign or symptom in N. C. A. which may not be caused by hyperthyroidism nor which is not observed at least in analogy in young women afflicted with Graves' disease. On the other hand, a more careful and prolonged study has shown me that this assumption is not satisfactory. Many cases show no goiter, but, of course, we all recognize that hyperthyroid secretion may easily occur without demonstrable goiter, but in this disease the predominance of the asthenic symptoms is so much greater than in simple Graves' disease that when they are well marked and the other evidences of hyperthyroidism wanting, and especially if it be found, as is frequently the case, that emotional states *only* cause the onset of the symptoms, one must be convinced that the real condition is something definitely more obscure than hyperthyroidism.

This conviction is further emphasized by the very frequent development of precisely this condition after the grave infections, and it has been the study particularly of these cases that has won me over to the conception that we are really dealing with something above and added on to hyperthyroidism in this syndrome.

The condition has frequently developed in my wards during the convalescence from pneumonia, from epidemic cerebrospinal meningitis, after rheumatic fever, and the like. It is impossible for me purely from the clinical picture to distinguish these cases from those which enter the service with the already developed N. C. A. Those postinfectious cases, however, unquestionably do far better as to ultimate result than the spontaneous or hereditary ones. Doubtless in the postinfectious cases also there is a certain degree of myocardial disease associated with the tachycardia, and it will never do to subject these soldiers to the same physical drill and stress as that on

which the congenital cases customarily thrive. Time alone effects a cure in the postinfectious group in a very large number of cases. I greatly question if time will produce this result in the more common congenital case. What is the place in this picture then of those cases which develop in the course of military effort? For the proper interpretation of these cases we must turn beyond doubt at this time to the experience of our British colleagues, for they have very extensively studied this aspect of the syndrome; doubtless precisely their problem will shortly be presented to us when we begin to have our sick return from the battle-fields.

Psychic rest and carefully graduated physical exercises, beginning with very light work, in the nature, of course, of drill, and leading on up to long hikes under the full weight pack and equipment, have so improved these cases that they have been able to return full 20 per cent. to line duty, a still larger percentage to light and domestic duties, and practically all to some sort of duty of use to the government.

We have for some months at Camp Upton attempted to carry out these ideas in our cardiovascular service, our cases being practically all of the congenital or hereditary type. One notes almost immediately that the cases when given drill or police work divide themselves automatically into two classes—those in which the heart rate is diminished by the exercise and those whose response to effort is poor. The first class of cases, which comprises by far the larger group, is much improved by this training with which is associated a certain amount of mental discipline, for these patients are told, and in my opinion quite truthfully, that they have no heart disease and that their condition is one which is curable and which is unquestionably benefited by work and drill. Those cases which fail to respond to the drill, that is, those which have persistently an increase instead of a diminished heart rate under exercise, are discharged from the service as soon as it can be brought about.

Favorable cases after their discharge from the hospital where we have so far as possible isolated these cases from all others, exacting from them a more strict compliance with military

discipline and customs, are sent to a Development Battalion in the main camp, where these men are theoretically given lighter military duty and training, theoretically under the close supervision of medical officers. The theory is good, but the actual working out of this plan has not thus far been satisfactory because of the lack of proper medical control of these men. The "regular" cannot believe but that all of these men are members of the genus malingerer, and at least in our camp the system has not had as fair a trial as has been given it in Great Britain, where apparently soldier material is more carefully conserved than is yet the case with us.

The experiment has, however, gone quite far enough to satisfy me that with these congenital cases a sufficiently complete restitution to normal status, so that full military duty is to be exacted, is not to be expected from this type of case.

Naturally the physician at once questions what of other methods of treatment, what of digitalis, of electric treatment, hydrotherapy, etc.? I confess that all of these methods have not received a fair trial at our hospital, but enough so to convince me as a medical officer, not as a medical man pure and simple, that my time in this direction is wasted. If we cannot restore these men to a real military status within a reasonable length of time and at a reasonable cost it is far better, in my opinion, to return them to civil life where many of them may carry on in a pretty satisfactory way; in the army their constant complaints and their military ineffectiveness causes them to be not an assistance, but a definite nuisance.

Rest in bed without exception causes these cases to become much worse. Management as though a cardiac case, that is, with greatly restricted exercise, etc., causes them to become worse, particularly in their emotional aberrations. Digitalis fails to slow the heart unless given in very large doses, and even then the heart efficiency in so far as may be judged by the exercise response is decreased rather than increased. The same is, of course, true of strophanthus. Caffein, strychnin, camphor, adrenalin, small doses of thyroid all definitely accentuate the symptoms of the disease. Bromids improve temporarily in

most cases, but, of course, their effect is not lasting and it cannot be considered as in any way a curative method. In my opinion there are no medical measures which are of benefit in these cases. The most successful treatment is, beyond doubt, psychic and physical training.

I have, as you note, not spoken in a very optimistic way in regard to even those cases which respond well to the physical training, that is, in so far as adaptation for military duty is concerned, but I am convinced none the less that a considerable number of these cases thus managed for a long period of time may be greatly improved, but I doubt if sufficiently so, so that they may be sent with wisdom and complete safety to full line duty, and I question very much the real economic value when the time and effort of the officers are considered from an economic basis as compared to the amount and character of military material thus saved.

Many, very many of these cases, however, are quite capable of undertaking other than line duty with perfect results. Some of our best clerks, paper men, ward masters, telegraphers, telephone men, quartermaster men, and even medical officers may be selected from this material. Bandsmen, kitchen workers, and many other places of necessary but not strictly military importance and work can be satisfactorily filled from this material. I very much regret that as yet no satisfactory method exists by means of which medical officers may thus select from this oftentimes valuable material men eminently valuable for these, but probably never available for real soldier duty.

As a physician I am very much interested in the effect which this method of training would probably have on these cases could they be selected or discovered in early youth. I am much of the opinion that if they could be put under treatment of a developmental character in early youth most of them would be entirely cured.

Now as to those cases which have developed as a result of or at least after the infectious diseases. Practically the same method of treatment is doubtless the best, but here much more discretion must be exercised and a most competent and con-

stant medical supervision is necessary, for in very many of these cases myocardial disease, either degenerative or inflammatory, is certainly present in greater or lesser degree. These cases cannot be thrown in with the congenital N. C. A. cases, though in every particular they resemble them except in the very important manner of origin. Here the intelligent use of digitalis, of bromids, of iron, of a carefully studied and supervised diet is all important. These cases must be physically trained, but in my opinion, which differs, it is true, from that of the greater experienced British officers, they must be considered as potential cases of organic disease and handled in precisely this manner. I know that in civil life I never realized so fully as now the absolute necessity for graduated physical drill in these cases. In my opinion it is far more necessary than any other one method, but it is not all, and the medical officer in his management of these cases must never forget that he is also a physician.

As for those cases to which we have occasionally referred in this informal talk, those which from the very outset show the definite picture of hyperthyroidism, though some of them may be improved as a result of the physical training, none of them, in my opinion, improve more than slightly; some of them are definitely made worse; they are utterly worthless as military material, not physically or mentally valuable in my opinion in any part of the military machine.

I have been asked definitely to say just what I think should be done with cases of this type from a military standpoint. I am glad of the opportunity. I would discharge absolutely all those cases which after a relatively brief period of observation seem to fall into the definitely hyperthyroid group. From the very large number of congenital cases I would select such as under a brief period of observation show themselves to respond fairly well to the physical tests and whose mentality or occupations are such as may be profitably utilized in the military mechanism. I would expect to find no congenital cases capable of undertaking full military line duty. These men should be placed in a development battalion where they may receive a sufficient amount of military training to fit them not for military

work, but to perform in a military way those special duties for which their mentality or training fits them.

The group of cases appearing after the infections should be most carefully selected and trained under an experienced cardiologist or medical officer with the aid of intelligent and considerate non-commissioned officers, but they must be considered as patients as well as men under modified military training. A large percentage of these men should be returned to full military duty, but if carelessly or inefficiently managed most of them will inevitably break or become a care instead of an asset to the nation at war.

EPIDEMIC PAROTITIS AS A MILITARY DISEASE

In the mind of the ordinary civil practitioner mumps is a disease of little importance. Its care in the large cities is chiefly in the hands of the pediatrist or general practitioner, and the usual attitude of the physician toward the disease is that it is a somewhat disagreeable condition of little economic or medical interest. Its occurrence in the adult is looked upon as rather unusual, and by most persons, except the patient himself, it is considered as something of a joke of a decidedly juvenile character.

The military medical man has, however, a definitely different attitude toward the disease. It is very frequent in the men of military age, that is, between twenty-one and thirty-one, and in the soldier it is known as one of the most frequent, most highly contagious and unmanageable of contagions. It is also one of the most difficult of the infections to trace or eradicate even among seasoned troops once that it gains a footing. The mortality rate is occasionally relatively high in encampments, but its chief factor of military importance is an economic one. Epidemic parotitis quite as thoroughly disqualifies asoldier for duty as may a shell wound or a fractured extremity. Epidemic parotitis may put a company, a battalion, a regiment, or even a brigade temporarily quite as thoroughly out of action as typhoid fever or cholera. Such being the case, an entire mili-

tary project may fail as a result of this apparently insignificant disease.

Measured in loss of time, in cost of maintenance, and from every military standpoint except that of burial and pension costs to the nation, mumps may be at times as important as scarlet fever or German rifle fire.

At Camp Upton alone during the time since the Base Hospital has been established, from September 5, 1917, to this date, July 12, 1918, 1059 cases of mumps have been under our care at this institution. At Upton 80 per cent. of these cases averaged sixteen days in the hospital; 15 per cent., twenty-one days; 5 per cent. remained four weeks or longer. Thus this apparently trivial disease as it has occurred at Camp Upton alone has cost the government approximately 18,520 days of service. In the comparatively small factor of pay alone, assuming that every sufferer from the disease was but of the rank of private, and this is by no means the case, it has cost the government $18,520, and when we add to this the cost of ration, about 45 cents per man daily, amounting to the neat little sum of $8335, the pay of officers, men, and nurses in necessary attendance upon the sick, the drugs, bed-linen, the housing, and transportation you can readily see that quite aside from the loss of military service in the crucially necessary time of training, mumps has been in this single cantonment of very considerable economic importance even to the United States of America. This is partly my excuse for presenting this problem to you.

There is another side of the question which will, I think, appeal to you with equal or even greater force. As we have compared our ordinary text-book account of this disease to the picture which has been unfolded in our wards we have been struck with the altogether inadequate theoretic presentation of the disease, and with the fact that each author seems to have very largely copied from another instead of backing his description from a wide clinical experience of his own. A very large number of important questions in regard to mumps which still remain unanswered exist in almost every phase of the

disease. To the candid student we have apparently added but little to the picture of the disease as given by Hippocrates, who defined it as a disease of children and young male adults, noting the involvement of the salivary glands, the absence of suppuration, and the frequency of orchitis. Even Hippocrates notes its decided preference for the male, and in our little hospital of but 2000 beds only 3 out of our list of 300 female nurses of approximately similar ages developed the disease, and thus it is classed at once as a disease of the male. And of these nurses, one was a dietitian and neither of the other two had, to our knowledge, any close communication with the mumps cases. We have not been so fortunate with the enlisted men, but with that strange protection with which the careless medico is invested, none of us have contracted the infection.

As with practically all the acute infections, mumps has appeared most frequently among rural rather than urban troops. Our percentage has been 85 per cent. rural and 15 per cent. urban. As is also generally known, it has in most instances attacked nearly all the exposed soldiers not immunized by previous attacks, but in nearly 50 per cent. of the instances affected a history of previous attacks of mumps has been given. While in many, very many instances this is due doubtless to mistaken diagnosis on the part of the patient, there can be no doubt whatever but that one attack of the mumps does not permanently immunize. One case in particular occurs to me: A young soldier came to our service with a typical parotitis involving one side, in the course of which an orchitis of the corresponding testicle developed. On the conclusion of the case he was sent to duty, but he returned to the same ward three weeks later with a typical picture of epidemic parotitis on the opposite side, which was again followed by a complicating orchitis. My observations in this epidemic has convinced me that to a considerable extent mumps is a localized disease—that is, it rarely recurs in the same gland twice—and there is much to commend the old lady's idea that the prognosis as to duration of the case is better when practically all of the usual glands are involved early in the disease, otherwise as one parotid

or submaxillary subsides an infection of the glands on the other side develops. This prolongs the case very materially and there is, to my mind, much to commend the idea that the disease is a localized infection and not a hemic or lymphatic disease.

A problem which has much occupied our interest has been as to the manner of inoculation. Of course from analogy it is very simple to assume that it is transmitted through the respiratory tract or that it is a buccal inoculation. Certain experiments with which I am acquainted, however, have failed to show infection by these avenues when it was attempted voluntarily, and even where the saliva expressed from an infected gland has been applied to the duct papilla of a person supposed to have never had the disease. The infection has not followed repeated inoculations in this manner. There is, however, no evidence but that our supposed test case may not have had at some time in the past an unrecognized mumps, or that he may not have had a natural immunity against the disease.

Cross infection where respiratory and buccal infection may well have been the avenue has been possible in very many clinical instances. That at times there exists at least temporary immunity against the infection seems to be undoubted, for cases frequently directly exposed to patients with the disease and yet failing to develop it have subsequently succumbed to what must have been a very slight exposure, sometimes merely a passing contact. This fact has been particularly illustrated in several of our ward men, who perhaps had left the service in the mumps ward, when after a considerable time they finally developed the infection apparently from some very transient exposure.

We have made an attempt to determine as accurately as may be as to the incubation period of a mumps infection. This we have certainly not been able to do, but in so far as we may surmise it is extremely variable. Some infections have apparently developed as soon as five days after exposure, others have gone as long (in one instance) probably as sixteen days, but in so far as we can surmise the average has been about ten or twelve days. We do not believe that the disease is con-

veyed other than by contact, that is, from person to person. I do not feel that it is conveyed by fomites at all. We have observed no recrudescences of the infection in organizations indicating an infection appearing as long as twenty-one days after the exposure, as Osler states to be possible. And I am of the opinion that if developing so long after a single exposure, infection by some intermediary agent must be considered.

As to the time during which a case remains infectious we cannot state specifically, but I am of the opinion that the disease may be transmitted as long as the active lesions—that is, the swollen glands—persist.

We have nothing new to offer as to the etiologic factor which primarily causes mumps. Much in the clinical picture of the disease as it has appeared to us indicates that it is not a general hemic infection, but one of the more or less accessible glands, for we have been unable to demonstrate the involvement of pancreas as one would certainly expect were the disease a hemic infection, since it shows so definite a proclivity for the racemose glands. The old suggestion that the disease is conveyed to the testicle by hand urethral inoculation has something to support it, but this theory does not explain those occasional cases, some 4 or 5 of which have been seen in this epidemic, in which orchitis preceded any demonstrable involvement of the salivary glands. It was intended to attempt to substantiate the well-known work of Martha Wollstein, but owing to the fact that our epidemic of pneumonia, which since it brought about the death of so many soldiers demanded our chief interest for the time being, this investigation was abandoned.

Most of our cases developed in troops brought to Camp Upton in divisions arriving from widely distant points, the number of cases developing in our own local division, the 77th, was very small, hence it would seem that there can be no question that a single strain of the infecting agent was alone concerned in the group of cases which I have been studying. Four distinct outbreaks of the disease, all originating from infections developed far from New York, have appeared in the same number of divisions which have mobilized at this camp. Colored

men have appeared to be the more susceptible to the disease than white soldiers (93 per cent.), and so also too they appear to me more liable to the reinfections than whites, if we may put sufficient dependence on the correctness of the former diagnoses.

There has been nothing striking in the manner of onset. In most cases no prodromal symptoms whatever have been present, and the first observation of the patient or of his comrades has been the swollen glands. Many cases during this stage present no more than a slight increase of temperature, 99° to 101° F., but a few exceptional cases have shown an onset with prostration and a high fever. Onset with chill is very unusual. As a rule, the temperature falls within forty-eight hours and remains down unless another gland becomes infected, when again a slight rise in temperature with a proportionate quickening of the pulse-rate appears. Orchitis is almost invariably accompanied by a much more marked rise in temperature, but, curiously, the pulse-rate has in most cases not proportionately increased, but has remained at a notably low rate.

The parotid gland has, of course, been the one most frequently involved and first affected, the submaxillary next, and last the sublingual. Not a single case of the involvement of the lacrymal glands has appeared in our large group of cases. There appears to be no regular order by which the various glands become involved secondarily, that is, one may have the parotid on one side and the submaxillary on the other, with perhaps the secondary invasion of the opposite parotid, submaxillary, and sublingual—again suggesting that the disease is not a hemic one. The more common occurrence of the successive invasion of the various salivary glands instead of their occasionally seen spontaneous invasion would also suggest the same assumption.

One of the most interesting observations which we have made has been as to the occurrence or absence of salivation. In most cases there has been but little alteration in the quantity of salivary secretion in so far as we could determine. In another group of cases, however, there has been marked salivation, and in still another considerable group the patients complained

of lack of sufficient saliva, and inspection of the buccal mucous membranes has shown a puckered, desiccated, and wrinkled appearance with markedly insufficient salivary secretion. My observation of this hyper- or hyposalivary secretion has borne no direct observable relationship to the glands or number of glands involved at that time. The old familiar household test of the taking of some acid substance—an acid fruit or pickle—has been valueless as a diagnostic means in the disease; some patients crave greatly the acids and others do find difficulty and pain in partaking of them.

Pain in the region of the involved glands is, in my experience, more due to the mechanical condition than to any other factor. When the swelling of the glands is great, as the result apparently of the mechanical pressure upon the nerve trunks, considerable pain may be experienced, especially upon movement of the lower jaw.

Microscopic examination of the salivary secretions has shown no apparent typical condition present. Doubtless there are certain chemical alterations, but our time and facilities have not permitted us to investigate this point, nor have we been able to study the buccal secretions for the specific cause of the disease, chiefly for the reason that our time for the work of this character has been limited by the insistent clinical demands of our very heavy service at the Base Hospital.

One does usually note that the papilla is edematous, swollen, and inflamed, but, in my opinion, not to a diagnostic degree. The duration of the swelling in any gland has been extremely variable, and has at times subsided very rapidly; again it has persisted in greater or lesser degree for several weeks. One may perhaps state with Osler that as an average about seven days' time passes before the swelling in a definitely enlarged gland has completely subsided.

As we have previously stated, the duration of the disease seems chiefly dependent upon whether all glands are involved at once, or whether the involvement of glands occurs slowly, which always greatly increases the length of disease.

The degree of prostration at the onset of the infection is

often very severe; it appears, however, to be in nowise dependent on the extent of the swelling or on the number of the salivary glands involved. One oftentimes finds tremendous swelling of the glands with few general symptoms and but little discomfort, and that apparently mechanical in origin.

Greatly prostrated cases are likely to develop mania, oftentimes a wild delirium, or the patient may subside into a comatose state simulating a uremia. Meningismus has not been a frequent symptom-complex in this epidemic, but three instances developed in our group, and none of them so marked as I have previously seen in civil practice. The disease, in so far as the clinical symptoms are concerned, has appeared to me no more severe in these soldiers than I have seen in children in civil work, nor has it seemed less severe. I refer now entirely to cases without the complication of orchitis.

In cases showing meningismus a certain degree of stiffness of the neck may be manifest. Care must be taken, however, not to confuse this with the natural stiffness of the neck which mechanically follows the swelling and turgescence of the parotids. A Babinski reflex may be present. If so, it is commonly inconstant, and some cases show an accentuated knee-jerk or unequal ones. In the three instances which have shown these symptoms in our group of soldiers no alterations have been found in the cerebrospinal fluid as removed by lumbar tap. None of our cases develop a true meningitis, as is sometimes reported, and as I have myself occasionally seen.

Ordinarily relapses during the course of the disease are not observed. This does not, however, refer to the very frequent prolongation of the disease by the involvement of other glands. This is, as I think you have all gathered from previous remarks, very common, and in our experience it is by far the wiser plan to confine all cases strictly to bed and to the ward rather than to the porches during all the active stages of the disease. If patients are allowed up too soon and especially if they are permitted to go about and out-of-doors, in our opinion a recurrence of the disease is to be expected.

I have previously mentioned one striking recurrence of the

infection occurring three weeks after apparent cure of the disease; very many cases have numbered the present attack as the second, third, or very rarely the fourth one of the disease. In our belief, immunity is more a matter of immunity of previously involved glands rather than of a general or systemic condition.

Complications in mumps as we have seen them have not been very diversified, but they have been very frequent; 24 per cent. have shown the most frequent complication, that is, orchitis. Just as with the involvement of the salivary glands, the degree of the swelling does not appear to be a measure of the severity of the systemic symptoms, but, of course, the degree of inconvenience and the severity of the pain is largely dependent upon the size of the involved testis. I have had my old conviction confirmed, viz., that traumatism of the testicles predisposes to the occurrence of orchitis, and I am convinced that injudicious palpation of a questionably enlarged testis may excite or determine an orchitis, and I am further convinced that even slight injuries to the organ when once involved may cause it to extend. I have learned to respect the patient's feelings in this matter very largely. Patients who have suffered a previous orchitis are almost certain to have involvement of the testicles in this disease. To us a new feature in the orchitis of mumps has been presented in the great frequency with which we have seen an epididymitis, either preceding, accompanying, or complicating the orchitis. In some few instances it has appeared independently of an orchitis, but usually associated with it. This frequency of epididymitis is not in accord with the usual text-book description of mumps, which has, of course, been chiefly based on the study of the disease in youths, often before puberty. It has not been accompanied by inguinal enlargement in most cases, but where it has developed (as has not infrequently been the case in cases suffering from a gonorrheal urethritis) it has been so found, and usually has been very severe.

As we have previously indicated, the orchitis may be the initial evidence of the disease, and not a few cases have been first referred to the venereal services because of this fact, and

have subsequently developed the salivary enlargement, etc., and fully complied with the diagnostic requirements of the infection.

It has occurred to us that it is quite possible that the frequency of occurrence of epididymitis with our cases may be associated with previous epididymitis due to old gonorrhea. This assumption is in part born out by the almost universal occurrence of both epididymitis and orchitis in cases which develop in the course of a gonorrheal urethritis. The high frequency of a history of a previous gonorrhea in many of our patients, which have been so largely among our colored troops (93 per cent.), a very high percentage of whom have or have had a recent gonorrhea may have a direct bearing on this complication.

With the development of an orchitis there is always a marked increase in temperature, oftentimes as much as 105° or 106° F., and occasionally with a chill. Temperature persists until the degree of the inflammation begins to subside. It is strikingly often seen that the rise in temperature is not accompanied by a corresponding increase in the pulse-rate, and in none of the cases has there been an increase in the polymorphonuclear leukocytes. While we are mentioning this fact it is interesting to note that as we have seen this infection the blood-picture is little or not at all changed either in simple or complicated cases, though occasionally there is a relative increase in the mononuclear leukocytes.

None of our cases of orchitis or epididymitis, even in cases complicated by acute gonorrhea, have developed pus formations in either epididymitis or testis, nor, for that matter, in the salivary glands, even though a urethritis, commonly with a sterile exudate, may appear. Atrophy of the testis is mentioned in some accounts of the disease as being a frequent sequence. It is not entirely possible to state definitely as to this in our cases, most of which have not remained under observation over from two to four weeks, but in two definite instances an apparent interstitial orchitis has developed which was apparently leading on to testicular atrophy when the cases were discharged to duty. Of course our control of our material has not permitted us to

make any observations on subsequent fertility. In 95 per cent. of our cases the orchitis or the epididymitis has been bilateral.

Under other complications mastitis has occurred twice. Otitis media has been seen several times, but only in cases giving a previous history of otitis media chronica or where the nasal or throat condition was such that this frequent condition might be expected to occur spontaneously and independently of the mumps, to which we believe it bears a casual relation. Thyroid goiter has been seen several times, especially where the parotitis was bilateral and marked. I believe it to have been mechanical rather than metastatic in origin. In 3 cases symptoms indicative of a possible pancreatitis have been observed; nothing very definitely conclusive of it, however, and a close study of this large group of cases with special inquiry as to this complication has been negative except for these possible instances.

Tonsillitis has been seen quite frequently, and in these instances and these only cervical adenitis has been present. Most of the cases have shown a streptococcus tonsillitis, and the occurrence of this complication is believed to bear no direct or important relationship to the specific infection. It is evidently incidental, perhaps favored by the more or less uncleanly condition of the buccal cavity, which may well be a secondary result of the disease.

Pneumonia has been quite frequent in our mumps wards, as it has been frequent in every department of the hospital. Part of the cases have been due to the pneumococcus of various types, but, as has been the case with our pneumonia epidemic outside these wards, streptococcus infections have predominated. Our only fatalities in mumps have been in those cases complicated by pneumonia, and in so far as we can judge the pneumonia has borne no more relationship to the mumps than it has to fractures, gastro-intestinal disorders, or any other large group of disease conditions with which we have had to deal.

No cases of very severe prostration, of hemiplegia, or of true meningitis have appeared in our series, and no cases of insanity have developed, though in several instances mumps has developed in cases of mental alienation. Arthritis has not been

seen except as it has developed apparently spontaneously, and when it has subsided under the use of the salicylates. Blood-cultures which have been extensively employed in all serious cases have been universally sterile. Albuminaria of a transitory character has been very frequent during the febrile periods of the disease, but in all instances it has cleared up and no true nephritis has been seen, although in many cases hyaline casts and occasional granular ones have been found in greater or lesser numbers. Neuritis has not been seen.

Epidemic parotitis as it has occurred in this camp has been a serious economic and military problem; it has cost the government much money and much time; it has necessitated the enlargement of our hospital, the increase of our staff, but it has figured only as a very negligible factor in our mortality lists even when it was complicated with other disease conditions. It has, however, lost us much valuable time in the training of our soldiers; it has obligated rigid quarantine measures, detention camps, and other very necessary restrictions of an irksome character from the military standpoint, but it has probably been a factor of almost no importance in so far as total disability for military service is concerned.

In so far as treatment is concerned we have immediately isolated recognized cases, and in a few instances we have isolated for a period of fourteen days soldiers in immediate contact with cases, but in our experience this is not a necessary or an advisable procedure from a military standpoint unless it is possible to at the same time continue the military training of the exposed men. Where this is possible no objection to the plan can exist, but from our experience, supplemented by the common judgment of military-medical men of wide field experience, the soldier not immune to this disease will sooner or later contract it, irrespective of such restrictions as we may lay down.

We believe that it is very important to immediately place all sufferers from this disease in bed and to keep them there at least until the active stages of the disease have passed away. By this simple and inexpensive procedure we believe that many of the serious complications of the disease may be avoided

and the severity of the infection and the duration of it considerably mitigated. We believe that confinement to bed and in warm and comfortable wards minimizes and limits involvement of the testis and greatly lessens the liability to relapse and recurrence.

We have universally opened the bowels by a brisk saline purge and kept the patients on a light fluid diet just so long as a temperature has been present, and on a low diet until they were able to be transferred to the convalescent wards, where they were required to do light drill, ward and kitchen police until after a period of easy soldier work they were able to return to full military duty. We have separated the patients by inter-bed screens in an attempt to minimize secondary infections, especially from streptococci and pneumococci, and we have treated each case symptomatically and as an individual.

In some cases heat has been applied to the enlarged glands; in other instances cold in the form of the ice-bag, but in most cases no local treatment has been applied, and where it has seemed to have been indicated the form has been largely determined by the symptomatic comfort which the patient experienced. The buccal cavity in all and the nasal cavities in many cases have been systematically cleansed by mild alkaline gargles and sprays, so as to minimize the infection of the adjacent spaces.

Great care has been exerted to prevent even slight traumatism of the testicles, and where an orchitis or epididymitis has developed the "Bellevue bridge" was universally employed, and here again heat or cold in the form of hot water or ice-bag, as seemed to give the patient most relief.

The important data still to be derived from a study of mumps as a military disease seems to be, first, the discovery of a means if possible by which immunity against the infection may be determined. Second, to discover the avenue of infection so that the spread of the disease may be limited. Third, to determine the incubation period. Our present studies in this epidemic are along these lines, but nothing definite has as yet been established on either of these phases of the condition.

Finally, of course the most important and elemental question from all aspects is the discovery and identification of the etiologic factor of the disease. Work along these lines has as yet given us nothing of sufficient surety to admit of clinical application at least, although definite progress in this inquiry has been made by several investigators and especially by Martha Wollstein. A great opportunity for broad studies of this nature is presented in nearly all of our great military hospitals at this time, but we must look to others than those burdened with the insistent clinical and military problems of the regular staff of our great hospitals for this help. The opportunity and the need is great, but workers capable of such a research are few.

THE BASAL METABOLISM IN CASES OF THE "IRRITABLE HEART OF SOLDIERS"

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Among the many complex problems which have recently attracted the attention of internists none has proved to be more baffling than the determination of the factors underlying the condition generally known as the "irritable heart of soldiers." Many names have been suggested as substitutes for that originally used by DaCosta, and much speculation has been indulged in as to the etiology of the symptom-complex, but comparatively few scientific studies have been made with a view to bringing out accurate facts. It is only by the correlation of careful observations, tested point by point by the most reliable methods on considerable numbers of cases, that one may reasonably expect to bring order out of what is now a clinical chaos.

At the present time, in the United States at least, the patients referred to the cardiac services of military hospitals for "irritable heart" or "functional heart disease" certainly do not represent one single clinical entity. The opportunity for more intensive study than is possible in most camps reveals that in many there is a definite organic basis for their symptoms, such as tuberculosis, myocarditis, valvular heart disease, outspoken hyperthyroidism, or neurologic disease. Even the remainder, in whom no evidence of organic lesion is to be found to account for the symptoms—the true instances of "irritable heart"—give rather varying clinical pictures, and it is quite probable that they represent several clinical conditions. Many of these cases resemble so closely what is known as the "forme fruste" of Graves' disease that the diagnosis of hyperthyroidism is frequently made, and, indeed, not a few physicians consider that

most cases of "functional heart disease" are due to overactivity of the thyroid gland. In view of this fact it was considered important that the relation of the thyroid gland to the symptom-complex of "irritable heart" should be investigated at General Hospital No. 9, at which institution special facilities have been provided for the study of these cases. The present paper deals with the results of the study of the basal metabolism in 59 cases.

METHOD

It is generally recognized that the most characteristic result of hyperactivity of the thyroid gland is the production of a rise in basal metabolism, and, indeed, observations on large numbers of patients in various hospitals have shown quite definitely that the severity of the clinical symptoms of hyperthyroidism runs closely parallel to the degree to which the metabolism is raised above the normal. The determination of the basal metabolism or of the heat production gives, therefore, at the present time the most accurate basis for deciding whether or not the thyroid gland is abnormally active. The methods used in the present investigation are standard ones and need not be described in detail. All determinations were made in the morning on patients who had fasted since the previous evening. After lying at rest in the laboratory until the pulse-rate was constant a mask covering the nose and mouth was applied. To this were attached inlet and outlet valves separating the inspired from the expired air. The latter was collected in a large (100-liter capacity) Tissot spirometer. The expired air was collected for periods of about ten minutes, and two or three periods were run. The expired air was then analyzed with the Haldane gas analysis apparatus (portable form). From the oxygen consumption and carbon dioxid production thus determined the respiratory quotient and the heat production in calories per square meter body surface per hour were calculated. Surface area was determined on the basis of height and weight from the curve of DuBois and DuBois. Heat production per square meter body surface was finally compared with the normal standards for age as given by DuBois and his co-workers

at The Russell Sage Institute of Pathology. They have shown that in normal individuals the metabolism may vary plus or minus 10 per cent. from the standard normal figures.

DISCUSSION OF EXPERIMENTAL RESULTS

The table on pages 510, 511 summarizes the results of observations on the basal metabolism of 59 patients. On account of the large number of cases recorded it is not possible to give the complete details of the experiments, and a few words of discussion are necessary. The results on each case represent the average of at least two periods. The two periods were run one after the other, the mask being taken off the face in between them, in order to rest the patient. The periods averaged between nine and ten minutes in length, and in no case were less than eight minutes long. In 48 out of the 59 cases the percentage of the metabolism in terms of the normal in the two periods agreed within 3 per cent. In 4 cases (Nos. 10, 32, 34, 44) the difference was 4 per cent.; in 3 (Nos. 7, 13, 40) it was 5 per cent.; in 1 (No. 56) it was 6 per cent.; in 2 (Nos. 35, 37) it was 7 per cent.; and in 1 (No. 17) it was 8 per cent. In none of these cases, however, were the results of either the high or the low period outside of the normal limits, with the exception of No. 56, mentioned later.

Abnormalities in the character of the respiration, undoubtedly due to nervousness, were observed in a number of instances. Thus the minute-volume of air breathed often varied to an unusual degree in the two periods. One might well have expected to find variations in the metabolism associated with this, but such was either not the case or else the variations in the metabolism were proportionally much less than the variations of minute-volume. The minute-volume does not bear the usual relationship to oxygen consumption. A similar nervous respiratory reaction may be seen in the rate of breathing, which is not infrequently considerably above normal (Nos. 19, 36, 37, 44, 56, 57). Here again there is no constant relation between the rate of respiration and metabolism, nor does the rapid respiration have any definite effect on the respiratory quotient.

BASAL METABOLISM DETERMINATIONS

Case No.	Name.	Register No.	Age.	Date.	Weight, kg.	Height, cm	Temp., buccal, degrees C.	CO_2 production per min., C.c.	O_2 consumption per min., C.c.	Resp. quotient.	Minute-volume, liters (S. T. P. D.).	Rate of resp.	Calories per sq. m. per hour.	Pulse-rate per minute.	Metabolism in per cent. of normal.	Preliminary diagnosis.
1	F. B.	1146	31	24/viii	79.1	181.0	98.3	218	266	0.82	6.45	17.9	38.7	73	— 3	
2	C. R. B.	723	23	18/vii	60.5	174.0		187	238	0.79	9.78		39.2	75	— 1	
3	M. D.	746	38	20/vii	53.4	169.5	98.0	172	207	0.83	5.06	15.5	37.3	60	— 6	
4	G. H. D.	868	32	27/vii	59.3	162.4	99.2	193	236	0.82	5.06	12.6	41.7	95	+ 6	Hyperthyroidism.
5	R. D.	1185	23	26/viii	51.6	173.0		160	204	0.79	4.46	12.5	36.4	81	— 8	
6	R. E.	1258	23	22/viii	59.8	176.0	98.6	179	220	0.82	4.80	15.9	36.6	66	— 8	
7	V. E.	1283	26	1/viii	53.9	166.5	98.4	169	223	0.76	4.58	13.4	39.6	82	+ 1	Hyperthyroidism.
8	J. G.	904	20	15/viii	55.5	170.3	98.3	163	210	0.78	4.81	19.6	36.4	71	— 8	
9	P. G.	872	23	25/vii	52.7	169.0	97.8	181	216	0.84	4.74	13.5	39.3	67	— 1	Hyperthyroidism.
10	G. G.	1186	27	20/viii	57.3	174.0	98.4	161	224	0.72	4.06	14.3	37.5	76	— 5	Hyperthyroidism.
11	E. G.	1069	24	7/viii	55.5	164.5	98.7	158	204	0.77	4.18	11.0	35.9	78	— 9	
12	L. R. J.	1021	23	14/viii	65.0	174.0	98.2	185	226	0.83	4.88	17.1	36.8	69	— 7	
13	G. H.	1227	31	16/ix	63.4	174.5	98.4	204	240	0.85	6.50	20.7	39.5	59	— 1	Hyperthyroidism.
14	K. K.	1226	23	29/viii	61.8	173.0		180	232	0 78	4.92	14.5	38.2	94	— 4	Hyperthyroidism.
15	F. K.		26	10/viii	58.9	171.0		178	220	0.81	5.77	21.5	37.6	75	— 5	Hyperthyroidism.
16	M. L.	1145	19	6/viii	60.2	167.0	98.7	202	233	0.87	5.74	16.5	40.8	83	— 1	Hyperthyroidism.
17	A. M.	875	22	26/vii	59.3	174.0	98.8	168	233	0.73	5.14	21.1	38.4	70	— 3	Hyperthyroidism.
18	W. N.	133	24	16/viii	64.8	187.0	98.3	200	247	0.83	5.85	16.3	38.4	66	— 3	Hyperthyroidism.
19	O. S.	899	19	29/vii	57.7	170.0	98.9	168	222	0.76	5.41	22.3	37.8	78	— 8	
20	J. T.	902	21	15/viii	65.5	169.5	98.2	179	236	0.77	4.80	14.5	38.3	58	— 3	
21	G. V.	1098	23	13/viii	59.1	166.0	98.8	171	218	0.79	4.84	16.2	38.0	60	— 4	
22	I. Z.	1230	22	21/viii	60.2	177.0		187	232	0.81	4.38	12.8	38.4	70	— 3	Hyperthyroidism.
23	S. Z.	221	24	1/viii	52.1	170.5	97.8	169	216	0.78	4.96	16.7	39.0	64	— 1	Hyperthyroidism.
24	G. A.	441	24	27/viii	68.2	173.5	97.4	203	254	0.81	5.47	15.6	40.1	80	+ 2	
25	H. B.	1143	20	4/ix	57.7	170.0	98.2	184	237	0.78	5.38	17.6	40.6	59	+ 3	
26	J. A. B.	866	23	29/vii	58.0	180.5	98.8	189	246	0.73	4.11	7.1	39.9	72	+ 1	Hyperthyroidism.

27	J. B.	1115	27	23/viii	63.6	168.0	97.8	215	243	0.89	5.80	14.1	41.4	65	+ 5	Hyperthyroidism.
28	J. F.	291	23	30/vii	58.0	171.8	98.6	186	236	0.79	5.38	17.3	40.6	80	+ 3	
29	W. W. F.	260	25	24/vii	63.9	177.0	97.8	196	249	0.79	6.23	23.4	39.6	80	+ 1	Hyperthyroidism.
30	V. T.	1419	24	17/ix	70.2	182.5	98.0	204	257	0.79	6.57	19.7	38.7	71	— 3	Hyperthyroidism.
31	F. K.	255	27	30/vii	60.7	174.8	98.8	190	245	0.77	5.50	18.3	40.5	83	+ 3	
32	J. K.	1177	31	17/viii	59.8	166.0		181	236	0.77	5.72	23.5	40.4	72	+ 2	Hyperthyroidism.
33	J. L.	884	29	7/viii	64.1	168.0	98.2	208	256	0.81	6.91	28.8	42.5	69	+ 8	
34	O. M.	737	23	23/vii	66.1	176.5	98.6	188	253	0.74	5.49	17.1	39.5	67	0	
35	W. R.	713	30	19/vii	58.4	174.5	97.7	184	244	0.76	5.00	14.3	40.6	60	+ 3	
36	G. S.	1110	22	15/viii	55.0	166.0	98.6	181	233	0.78	6.12	31.1	41.6	82	+ 5	Hyperthyroidism.
37	S. J. S.	388	17	24/vii	55.2	171.5	97.2	197	257	0.78	7.64	36.2	44.5	74	+ 4	
38	W. S.	1149	25	5/viii	61.4	170.5	98.7	197	239	0.83	5.11	19.2	40.1	72	+ 2	Hyperthyroidism. Goiter, simple. Mitral insufficiency.
39	B. S.	1103	20	8/viii	62.3	170.0	98.6	189	247	0.77	5.73	20.1	40.5	73	+ 3	
40	W. Z.	873	24	25/vii	68.2	174.0	98.6	191	259	0.74	6.01	21.3	40.0	69	+ 2	Hyperthyroidism.
41	P. D.	1273	21	5/ix	56.1	168.5		180	220	0.82	5.23	16.0	38.8	72	— 2	
42	S. G.	1284	26	26/viii	61.8	180.0		187	231	0.81	4.93	15.3	37.3	66	— 6	
43	R. C.	874	24	17/ix	53.2	176.0	98.3	173	206	0.84	5.15	17.4	36.1	57	— 9	Hyperthyroidism.
44	A. R.	881	29	3/viii	52.7	161.3	97.7	159	198	0.80	5.17	24.9	36.8	72	— 7	Hyperthyroidism.
45	J. J. H.	766	23	22/vii	61.6	173.5	96.2	170	216	0.79	4.72	17.8	35.6	53	— 10	
46	M. H.	1104	23	8/viii	63.4	168.0	98.4	170	216	0.79	5.66	24.8	35.7	62	— 10	Mastoiditis. Goiter, simple.
47	H. N.	879	30	27/vii	64.3	181.0	97.8	178	230	0.78	5.89	24.4	35.7	65	— 10	Hyperthyroidism.
48	N. A. P.	891	22	31/vii	77.3	191.0	98.2	193	256	0.75	5.16	15.5	35.5	55	— 10	Hyperthyroidism.
49	C. H.	949	24	14/viii	61.8	164.0	98.6	157	206	0.76	4.09	17.6	35.3	55	— 11	
50	W. B. H.	934	30	9/viii	51.4	167.0	98.5	164	189	0.87	4.45	14.8	35.3	64	— 11	
51	E. M.	707	20	13/viii	63.6	171.5	98.2	175	213	0.82	4.62	12.9	35.1	67	— 12	
52	H. V.	777	24	18/vii	61.4	176.0	98.0	172	197	0.87	3.99	10.3	33.0	59	— 17	
53	E. H.	775	23	22/vii	56.6	161.0	98.8	204	237	0.87	4.65	14.1	43.9	74	+ 12	
54	D. C.	1148	26	30/viii	63.0	177.0	97.8	231	272	0.85	6.15	16.9	44.6	70	+ 13	
55	J. S.	870	24	22/viii	69.1	164.0		286	266	1.08	9.27	15.4	45.8	84	+ 16	
56	F. S.	721	23	19/viii	63.4	173.0	96.8	235	285	0.83	10.80	45.7	46.6	64	+ 18	
57	W. P.	933	23	31/vii	59.7	166.5	98.7	213	279	0.77	8.55	53.3	48.0	85	+ 22	
58	T. M.	851	19	23/vii	64.5	172.5	98.8	316	403	0.79	7.27	15.5	65.7	103	+ 60	Hyperthyroidism.
59	R. J.	1114	27	6/viii	50.0	165.5	99.0	256	344	0.75	7.66	19.8	63.4	120	+ 61	Hyperthyroidism.

Case 2 was an extremely neurotic individual and illustrates well these respiratory phenomena. In the preliminary rest period the rate of respiration was 36 per minute. After the mask was put on it increased until it reached 102 per minute in the second period. The oxygen consumption remained practically unchanged (243 c.c. in the first and 233 c.c. in the second period), and the respiratory quotient remained normal (0.73 in the first and 0.84 in the second period). The minute-volume was 7.86 liters in the first and 11.69 liters in the second period. It is interesting that in spite of this marked evidence of nervousness his pulse only changed from 60, while he was at rest without the mask, to 78 in the first and 71 in the second period. The heat production was the same in both periods, and the metabolism 1 per cent. below normal.

The average respiratory quotients were normal in all except Case 55. This patient breathed deeply at a nearly normal rate (minute-volume 9.27 liters) and probably "washed out" carbon dioxid.

The basal metabolism was within 10 per cent. of the normal limits in 48 cases, and within 15 per cent. in 53 cases. One patient (No. 52) had a metabolism 17 per cent. below normal, and at a second observation some time later it was found to be 19 per cent. below normal. No cause for this low metabolism was discovered. Two cases (Nos. 58, 59) had a metabolism 60 and 61 per cent. respectively above normal. These were both frank cases of exophthalmic goiter. Three other patients had a metabolism from 16 to 22 per cent. above normal. One of these was a man with hysteric aphonia, and the other two were nervous individuals, rather typical cases of "irritable heart," who were without evidence of hyperthyroidism.

DISCUSSION OF CLINICAL CASES

Fifty-nine cases are reported on whom the basal metabolism has been studied. Two of these (Nos. 58 and 59) showed all the classical symptoms of exophthalmic goiter. The remaining 57 cases all had hearts that were normal on physical examination, but had the typical symptom-complex which is character-

istic of the so-called "irritable heart of soldiers." It is to this group of 57 cases that attention is especially directed. In 24 cases (see table, pages 510, 511) the diagnosis on transfer to this hospital or the preliminary diagnosis of the Ward Surgeon here was hyperthyroidism; in 14 it was functional heart disease; and in 13 it was some type of organic heart disease. The others were sent to the hospital with various diagnoses (mumps, flat-foot, hernia, periorchitis, etc.). After careful study here the diagnosis of "cardiac disease, functional" was made in all these cases. The great majority were of what may be termed the "constitutional type"—with symptoms dating back over many years—but a few (Nos. 9, 25, 41, 46) dated the onset of their symptoms to a recent attack of rheumatic fever or other infection. In these cases, of course, the possible existence of a slight organic lesion cannot be excluded. In several (Nos. 8, 51, 56) the symptoms developed quite definitely after being under fire in France.

With regard to the relation between hyperthyroidism and "irritable heart" it is of interest to analyze the studies of basal metabolism in this group of 57 cases, bearing in mind the fact that definite overactivity of the thyroid gland evidences itself by causing the metabolism to increase above the normal limits. The normal variations are usually accepted as being 10 per cent. above or below the normal standards, but no very definite significance can be attributed to a rise of 15 per cent. above the normal. Of the 57 cases studied, 52 had a metabolism below 10 per cent. above and 54 below 15 per cent. above the normal standards. The metabolism in all of these was thus essentially normal. Three cases, with a metabolism of 16, 18, and 22 per cent. respectively above normal, must be considered from the point of view of their increased metabolism. The first of these was a fat, neurotic, constitutionally inferior man with a history suggestive of epilepsy. The second was the patient mentioned before with hysteric aphonia. In neither instance did the diagnosis of hyperthyroidism suggest itself at all. The third was a nervous individual who complained largely of pain in the chest on exertion. A rather full thyroid gland, which was,

however, without thrills or bruits over it; slight lid-lag; and a transient tachycardia during the examination brought up the possibility of this being a case of Graves' disease, but the general appearance and the history made it extremely unlikely that this diagnosis is the correct explanation of the high metabolism. Considering the fact that many of these patients were unusually nervous, it is rather remarkable that so few had a metabolism at or so slightly above the normal limits.

In spite of the fact that the metabolism studies lend little support to the view that overactivity of the thyroid gland is a factor of importance in this group of 57 cases, nevertheless the clinical diagnosis of hyperthyroidism was made by competent observers in 24 instances—and curiously enough none of these were patients with a metabolism above normal. That the diagnosis was made so frequently depends undoubtedly in part on lack of time and lack of proper facilities to study the patients, but in part, also, on certain superficial resemblances between these cases and cases of exophthalmic goiter. Nervousness, often in marked degree, is almost constant in the functional heart cases. A tremor of the hands is present which cannot always be differentiated from that of Graves' disease. The thyroid gland is often rather full and the isthmus easily palpable, but this is usually accounted for by the fact that the patients are at an age when the thyroid is often somewhat large, and in many instances by the patient coming from a region where goiter is endemic. Thrills and bruits over the gland, so frequently found in exophthalmic goiter, are very rare. Eye-signs suggesting Graves' disease are not very uncommon, and well-marked lid-lag was noted in several cases in which there was little or nothing to suggest a diagnosis of hyperthyroidism. Tachycardia, reaching 120 to 130 or even more, is very frequently present when the physician examines the case. This tachycardia is, however, essentially different from that seen in exophthalmic goiter, for it disappears if the patient is allowed to lie down quietly for half an hour. The pulse counts taken by the nurse in the morning are usually normal, and in only 2 cases out of the 57 was the pulse-rate above 90 during the metabolism observation. It was, indeed, above 80 in only 9 cases of the

group. This tendency of the pulse-rate to fall to normal when at rest and in the absence of excitement is quite different from the characteristic findings in exophthalmic goiter. One might argue that these are mild cases of Graves' disease in which there is only slight overactivity of the thyroid, insufficient to cause a demonstrable rise in the metabolism. Several points, however, are apposed to this hypothesis. In the first place, the nervousness and tremor are often so marked that, from comparison with other definite cases of Graves' disease, one could be certain that the metabolism would be increased. Second, if cases of mild hyperthyroidism were so common it would be almost inconceivable that outspoken cases would remain rather rare. And finally, the whole clinical picture of the two conditions is fundamentally different. In the cases of "irritable heart," as seen at this hospital, one usually gets a history of prolonged, often life-long, nervousness, associated with weakness, rapid fatigue, and lack of energy or ambition. There is always the tendency for the patient to "spare" himself, to "go slow," and to "take his own time." The more acute nervousness, with rapid loss of weight and diarrhea, which is characteristic of Graves' disease, is absent. The nervous activity, the restlessness, the physical and mental energy of the patient with hyperthyroidism give place in the cases of "irritable heart" to a condition of physical and sometimes mental inertia, and a desire to evade even the normal strain of life. The patient with exophthalmic goiter will usually take his rest-cure only under protest; the patient with "irritable heart" would adapt himself to the same treatment only too readily. Psychologically they are fundamently different.

The observations reported here thus confirm the opinion expressed by Lewis and his co-workers[1] in England, who investigated the same problem by studying the effects of administering thyroid extract to patients with "irritable heart," and they lead us to conclude that in America also hyperthyroidism does not play a significant rôle in the production of the symptom-complex of the "irritable heart of soldiers."

[1] Report upon Soldiers returned as cases of "Disordered Action of the Heart" or "Valvular Disease of the Heart," Medical Research Committee, 1917.

NOTES ON THE DIAGNOSIS OF ACUTE INFECTIONS IN THE THORAX

By Major Lawrence Litchfield, M. C., U. S. A.
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Faced by our mistakes in diagnosis, our disappointments in treatment, the very different observations and conclusions of apparently equally good men, and the variation in physical signs and subjective symptoms produced by what seem to be identical conditions, we feel at times that this subject is chaotic and our gropings futile.

In considering the diagnosis of the more puzzling and anomalous cases of disease of the chest we must recognize at the outset that certain physical signs have been misunderstood, and certain errors of conception and interpretation tend to perpetuate themselves. The medical student studies, for instance, a typical case of pneumonia, follows it to the postmortem, where the diagnosis is confirmed, and thereafter dulness, prolonged expiration, bronchial breathing, bronchophonic voice and whisper, and crepitant râles stand in his mind for lobar pneumonia, not merely for interesting phenomena of acoustics which may be due to very different causes under different conditions.

PNEUMONIA

The transition from acute bronchitis to a bronchopneumonia, whether interstitial or lobular, may be very insidious. A chill and sudden or gradual rise of temperature and sharp pleuritic pain in one side (the occurrence of a unilateral pain in the chest is strongly indicative of pneumonia) and a sudden change of the R. P. ratio are the signs likely to mark the beginning of the pneumonic process. The true rusty sputum of lobar pneumonia is at least very rare in the streptococcus cases. The viscid, gluey sputum of pneumococcus infection I have never seen in a

streptococcus pneumonia. Profuse hemoptysis may occur from either infection. One of our streptococcus pneumonias was estimated to have lost 1500 c.c. of blood by hemoptysis. In our streptococcus cases the leukocytosis was not as high as it usually is in pneumococcus infection, and the proportion of polymorphonuclear leukocytes was not as great.

The clinical picture of streptococcus bronchopneumonia (probably in all cases of the interstitial type as described by McCallum) was very well described at Camp Lee by Lieutenant Rivers as follows: "Sore throat, coryza, cough, mucopurulent expectoration, headache, general malaise, with pains throughout the body, fever, anorexia, and at times nosebleed, are the usual symptoms elicited in taking the history of the onset. During this stage the patient may not go to bed and may even remain on duty. After the above symptoms have existed for a few days the patient may be taken with a chill and a sharp pain in one side of the chest, and it is at this time that he is sent to the hospital. A few cases seem to become ill suddenly with a chill and pain in the chest."

As the interstitial pneumonia develops "the picture becomes a very distressing one. There is a look of anxiety on the patient's face, dyspnea becomes more and more extreme, with both inspiratory and expiratory embarrassment; he is restless, cannot sleep, the face becomes congested, puffy, and slightly cyanotic, there is a distressing cough," which is probably in large part due to the irritation of the pleura, "and at times literally exhausts the patient. The eyes are wide open, with glistening sclera, the lips parched and cracked, the tongue, mouth, and throat dry, so that often there is difficulty in speaking, and questions are answered briefly and in a whisper. The patient sometimes fairly fights for air; there may be drenching sweats, the temperature is irregular, the pulse is rapid, often weak and running—not at all the bounding pulse of lobar pneumonia."

If, however, the patient develops a large pleuritic effusion with only slight lung involvement the picture may be very different. He is quiet, does not wish to be disturbed, may be drowsy, and hard to arouse.

The importance of the bacteriologist in the proper study of these cases cannot be overestimated. Inefficient laboratory technic leads to failure in typing of the pneumococcus, so important in the treatment of the type "1" cases, and also to the classification of many streptococcus cases as group "4" pneumonias, and of many hemolytic streptococcus as non-hemolytic. That the non-hemolytic streptococcus ever causes pneumonia is very much to be doubted.

Blood-cultures in the early stages of the hemolytic cases were very rarely positive, occurring but once in the last 23 cases. In the last stages of the fatal cases it was more common. The sputum must be relied upon chiefly for the recognition of the invading organism.

Lieutenant Rivers, working on my cases in the ward and in the laboratory, developed the following valuable notes on what he called "pit-falls":

1. The collection of the sputum is most important. Most interns, to say nothing of nurses and orderlies, do not know what a good specimen of sputum is. If collected during the night and sent to the laboratory the next day, to stand about indefinitely, it is autolyzed before the attempt is made to examine it. After it is autolyzed it cannot be washed. The sputum should be collected by an expert who sees that the patient coughs the specimen taken directly from the lungs after the mouth has been rinsed.

2. Not enough sputum is usually added to the Avery tube. From $\frac{1}{2}$ to 1 c.c. of the washed sputum should be taken.

3. The acid developed by the growth of the pneumococcus or streptococcus in the glucose medium, unless neutralized, will precipitate bile-salts in a colloidal mass which cannot be cleared up.

4. The Avery tube should not be used for agglutination tests, but only for the precipitin reaction. Type IIa and Group IV are best differentiated by agglutination.

5. Glucose-agar plates or glucose broth should not be used for working with hemolytic streptococcus on account of the acid formation, which interferes with hemolysis.

Rusty sputum with the classical signs and symptoms followed by a crisis generally means lobar pneumonia, but lobar pneumonia may show a mucopurulent sputum due probably to a mixed infection, as with Bacillus influenzæ or hemolytic streptococcus, and the defervescence may occur by lysis instead of by crisis.

The differentiation between lobar pneumonia and bronchopneumonia, either interstitial or lobular, although oftentimes very difficult, can generally be made if careful clinical observation is made by an experienced internist, and if an equally experienced bacteriologist and roentgenologist work hand in hand to get the necessary reliable data.

Fig. 108.—Diagram of distribution of pleuritic effusion or exudate. Frozen sections will not show this because the negative pressure of the pleural sac and the vitality of lungs and muscular tissue are no longer acting.

We must recognize from the outset that the traditional signs of pneumonic consolidation may occasionally be present over a pleuritic effusion. On the other hand, tubular breathing, vocal resonance, and the abnormal conduction of the whispered voice, usually characteristic of hepatization, may be diminished or absent over a pneumonic consolidation on account of (1) plugging of bronchi (may be cleared by energetic coughing); (2) by pleuritic exudate, serous or plastic; (3) possibly by a thickened pleura (I have rarely if ever seen on the autopsy table sufficient thickening of the pleura to explain the physical signs so often disposed of on that hypothesis); (4) pressure on the bronchi leading to the solidified area; (5) unknown causes, probably due to interference, reflection, and absorption of the sound waves due to varying combinations of density and pressure.

While bronchopneumonia is usually disseminated and often-

times impossible to locate by percussion or auscultation, it is often unilateral and sometimes causes the consolidation of an entire lobe, thus giving the physical findings of a lobar pneumonia. On the other hand, a pure pneumococcus infection which we associated with lobar consolidation may kill the patient before there are any physical signs beyond diffuse pulmonary congestion. We usually make the mistake of expecting the signs of advanced hepatization in the very early stages of the disease. This is well emphasized by Landis.

One of my most valued experiences during the past year has been the opportunity at Camp Lee of working for many months with Major Merritt, who was one of the first roentgenologists to recognize the great value of fluoroscopy in acute thoracic conditions and the infinite superiority of the screen over the plate methods in these cases. It is very largely to Major Merritt's tutelage that I owe my appreciation of this method. Except for the purpose of record and teaching the use of plates should be discouraged. When plates or prints are made for the latter purpose the greatest care is necessary in developing and printing in order to show truthfully the progress of a case.

In describing and recording the shadows observed in this work we adopted the liver shadow of the case under observation as the standard of density. This we denoted as "1," describing less dense shadows as fractions and the least noticeable change as "smoky."

The value of fluoroscopy as an adjunct to a careful study of the history and physical findings in all cases of acute infections within the chest cannot be overestimated. In lobar pneumonia the Roentgen phenomena which we observed were the following: First, localized or diffuse cloudiness with marked restriction of the diaphragmatic excursion on the affected side (except in cases of central pneumonia free from pleuritic irritation). Not infrequently a distinct localized shadow in the lung will clear up in the course of a few hours, while a similar shadow appears in a different lobe, possibly on the opposite side. This may proceed to a complete lobar hepatization. The stage of hepatization is characterized by a shadow which increases in density

as consolidation advances until a density of "1" is attained, and if it be a lower lobe the line of the diaphragm is lost except when it is outlined on the left side by air in the stomach. There is usually diffuse smokiness over the balance of the lung on the affected side, and not infrequently on the opposite side. There is no stated period for resolution to occur. A partial hepatization may clear up at the end of twenty-four to forty-eight hours, and more complete consolidation shows a gradual fading of the density of the shadow until after days, or possibly weeks, an almost normally clear area is left, traversed more or less with linear markings extending from the hilus to the periphery. In cases of delayed resolution after the density of the shadow has diminished to "$\frac{3}{4}$," "$\frac{1}{2}$," or less, it may remain stationary for several weeks. We have several times seen the development of a shadow of the density of "1" in the parenchyma of the lung with positive laboratory findings and the clinical phenomena of severe pneumonia, but without the expected physical findings, followed by crisis and recovery, and the disappearance of the shadow, which had never reached the periphery and naturally had not been accompanied by signs of pleurisy or by any restriction of the movements of the diaphragm. In these cases the shadow faded into the normal lung with a mossy or lace-like margin. One of these cases did not recover and the diagnosis of central or hilus pneumonia, which could not be made out by physical examination, was confirmed by autopsy. Major Merritt, Lieutenant Stern, and myself gradually gained the conviction that a shadow approaching the density of "1" situated near the hilus and gradually fading toward the periphery was, in all probability, due to hepatization, and that a shadow of a like density situated at the periphery and fading toward the hilus was, in all probability, pleuritic fluid. In the latter case the margin might be sharply defined or might gradually fade out, according to the location and character of the adhesions which confined the fluid.

These observations indicate that at Camp Lee during the winter of 1917–18 the development of pneumonic consolidation in adults was the opposite of that which has been so well described

in children by Chapin and by Mason. As hepatization approached the periphery it was found that it might cause dulness before it caused bronchial breathing or bronchophony. On the other hand, I feel that hepatization at the periphery which does not extend deeply toward or perhaps to the hilus, may cause suppression of breath sounds simulating a pleuritic effusion.

A logical combination of fluoroscopy and percussion is sometimes very interesting. If fluoroscopy reveals a shadow which does not move with respiration it is either due to a pocket of fluid or an area of hepatization fixed to the chest wall by pleuritic adhesions. The percussion will show whether this pathology is anterior or posterior or includes the entire anteroposterior diameter of the chest. The shadow may approximate the location and area of the middle lobe and percussion may determine in the presence of other phenomena of pneumonia whether it is the middle lobe or the upper portion of the lower lobe which is involved. If the shadow is movable, tending to follow the shadow of the diaphragm down and up, it indicates either hepatization or a pulmonary abscess. Percussion may show whether it is in the middle lobe or the upper part of the lower lobe, while a very sharply defined margin on the screen or on the plate is evidence in favor of abscess formation or an interlobar empyema, the shape of the shadow in the latter case being sometimes suggestive. Cases of lobar or bronchopneumonia which later develop a hectic type of temperature with chills, etc., and in which the fluoroscope or the skiagram does not show the dense well-defined shadow of a single large abscess, or the recognized evidence of empyema, are very likely to die of multiple pulmonary abscesses. This is an observation of Landis which we confirmed at Camp Lee.

PLEURISY WITH EFFUSION

Most physicians think of a pleuritic effusion as gradually accumulating in the pleural sac and pushing up the lung, which, being full of air, floats on its surface.

Tradition has it that the upper surface of the fluid follows a graceful, compound, curved line, ascending steeply from the

front of the chest, across the axilla, and on toward the spine. This sometimes seems to be supported by *percussion* owing to the resonance of the lung underlying a varying amount of fluid.

Let us consider the physical facts. The pleura is a closed and empty sac not communicating with the outside air. Its visceral and parietal surfaces are in contact and held so by the fact that when the capacity of the chest is increased (enlarged) by raising the ribs and depressing the diaphragm the lungs are expanded by the inrush of air. If the glottis were suddenly occluded and the chest expanded the lungs would be distended by the inrush of blood and to some extent by the expansion of the air in the lungs and of the tissues themselves. Of course we cannot conceive of a vacuum being created in the pleural sac.

Let us note here one other important fact. The elasticity of the lungs is acting all the time and acting in a direction away from the pleura, tending to empty the lungs and contract them. This is the force which empties the lung when the chest is opened, and it acts constantly all over the surface of the lung and acts centripetally. This is the fundamental reason of the negative pressure in the pleura, and this negative pressure is greatly increased by the expansion of the chest. This negative pressure restores the dome of the diaphragm when that muscle relaxes and favors (with the plus pressure of the abdominal cavity) the gradual displacement of abdominal viscera into the chest by evisceration, when the diaphragm is paralyzed. This negative pressure in the one pleura, when not balanced by a corresponding negative pressure on the other side, tends to displace the mediastinum.

So much for the normal; now for the pathologic. Imagine some fluid in the pleural sac. Is it possible to conceive of a "horizon" without air over the fluid in a sac with negative pressure? Is it not natural to suppose that this fluid will be distributed over the entire pleural surface—the law of gravity determining only an increased thickness of the "layer" of fluid toward the base—and that with each expansion of the chest, with the pull of the chest wall away from the lung, this fluid in the pleura will tend to readjust itself and will act simultaneously

with the air entering the lungs? The fluid will accumulate most where the parietal pleura moves most and quickest from visceral pleura on inspiration, therefore Litten's sign is quickly lost. Fluid will tend, however, to move to every point where there is a tendency on inspiration for parietes to move away

Fig. 109.—Plate of a massive pleuritic effusion on left side. Note displacement of mediastinal shadow to the right. The trachea and large bronchi show unusually well. A poorly defined stomach bubble, possibly encroached upon by right lobe of liver, enlarged. (These plates were made by Captain Leighton R. Cornman and Captain James F. Kelly, of the Base Hospital, Camp Grant, Ill., who have been untiring in their assistance in this study.)

from viscera. There can be no upper surface of the fluid in the pleura, much less a horizon.

Furthermore, the greater the amount of fluid exudate in the pleura, the less the negative pressure, until finally the pressure becomes positive and eventually so strongly positive that the

intercostal tissues are bulged outward, the ribs elevated, the diaphragm depressed, and the entire mediastinum displaced markedly to the other side. Such a case is shown in Fig. 109, which shows unusually well the displacement of the trachea.

Although there is usually some pleuritis with lobar pneumonia, a large exudate is unusual, while with the hemolytic streptococcus pneumonias a large exudate is the rule. Therefore when the laboratory report of blood or sputum examination is streptococcus, we should watch carefully for signs of fluid. The typical case of pleurisy with effusion cannot be overlooked if the attendant is on his guard. The severely painful catch in the breathing, which inhibits the expansion of the side affected, the painful, persistent, unproductive cough followed by the signs of fluid, of which the most important are flatness on percussion with the characteristic feeling of resistance, absence of tactile fremitus, suppression of breath sounds or distant breath and voice sounds and egophony, with absence of Litten's sign, lateral displacement of the area of superficial cardiac dulness, Grocco's sign, dulness on percussion over the spines of the vertebræ, and, finally, bulging of the intercostal spaces, or even of the entire side of the chest, may leave no room for doubt. (Dilatation of the pupil on the affected side is often an interesting phenomenon, but scarcely has any diagnostic value.) In the case of a large effusion in the right pleura, there may be dulness and bronchovesicular breathing on the left side over the displaced heart with Litten's sign exaggerated on that side.

Just a word regarding spinal percussion, *i. e.*, percussion over the spinous processes of the vertebræ. Marked dulness here is a good sign that a neighboring dull area is fluid and not hepatization. It may be explained by the negative pressure on the sound side, displacing the fluid toward that side and the vertebræ acting like an inverted Herschfelder's plexímeter carrying the stroke and the sound through the spinal muscles.

Use the ulnar side of the hand for palpation of fremitus. Percussion upon the distal phalanx of the finger used as a plexímeter and held firmly applied to rib or intercostal space, one at

a time. Percussion with light, almost soundless, staccato touch. But if the case has begun with signs and symptoms of pneumonia and the fluid has accumulated insidiously, and especially if, as noted above, the physical signs are anomalous, or even simulate those of hepatization rather than fluid, we find fluoroscopy of inestimable value.

Fig. 110.—Aug. 28, 1918. Beginning pneumonia, right lower lobe. Spasm of diaphragm on right side, two distinct curves. Cloudiness of left base, shown by stereoscopic plates to the left lower lobe. Plate taken for suspected tuberculosis of the left *upper* lobe. Bad family and personal history, acute symptoms due to onset of lobar pneumonia.

When one side of the chest does not expand with respiration we must first consider whether it (1) *cannot* or (2) will not. (1) May be due to (*a*) a large pleuritic effusion, (*b*) an excessive closed pneumothorax, (*c*) an advanced emphysema (this, of

course, is not an acute condition). (2) Is due to pain—(*a*) pleuritic, (*b*) peritoneal, or (*c*) in the chest wall (the so-called intercostal neuralgia or pleurodynia). If the chest cannot expand, it is in the position of expansion, and the ribs, if visible

Fig. 111.—Aug. 31, 1918. Distinct shadow in right lower lobe, plainly seen on the screen to move up and down with respiration. Outline of diaphragm not obscured on the screen. Left lower lobe has almost entirely cleared. Physical signs, Sept. 1, 1918, right lower lobe, dulness, tubular breathing, bronchial voice and whisper.

on the fluoroscopic screen, are nearly horizontal and widely separated, while the diaphragm is flattened.

If the side of the chest "will not" expand because inhibited by pain, the ribs are oblique and close together and the diaphragm is highly domed.

In considering the differentiation of fluid from hepatization by fluoroscopy we note the following facts:

The density of the shadow may be the same in either case.

A shadow which moves with respiration must be in the lung.

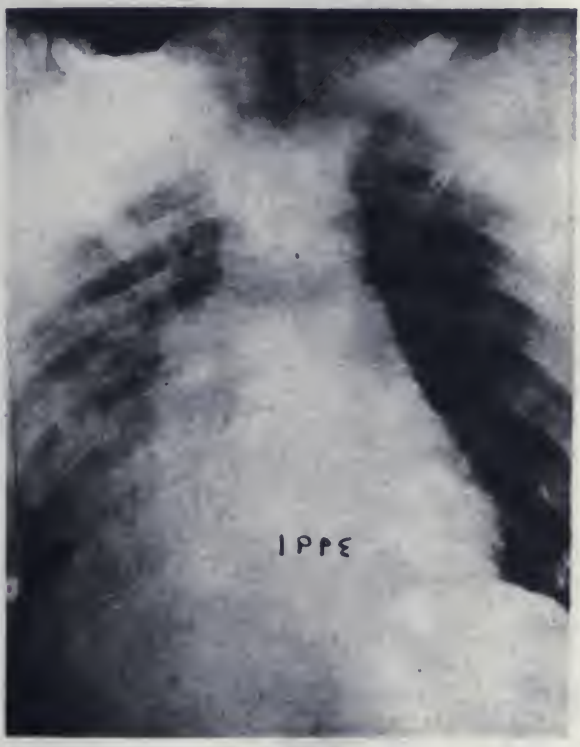

Fig. 112.—Sept. 3, 1918. Right pleural effusion added to right lower hepatization. Line of diaphragm almost lost. Fluid causes smokiness to very apex. Entire left side is clear. Mediastinal shadow slightly drawn to left.

A small amount of fluid in the pleural cavity will obscure the outline of the diaphragm and shade to a faint smokiness at the apex.

Inflammation of the pleura always inhibits the respiratory movements of the diaphragm.

Most of these cases are examined horizontally, but when their

condition does not contraindicate their sitting up, the effect of gravity may be noted in a darkening of the shadow below, while it becomes lighter, but not clear, above.

Coughing, if fairly forceful, shows a distinct and striking change in the density of the shadow due to fluid. It "flashes"

Fig. 113.—Sept. 5, 1918. A typical crisis occurred during the preceding night. From fluoroscope or plate the diagnosis would be, fairly large pleuritic effusion. Marked but not great displacement of mediastinal shadows.

darker, because it is concentrated in a smaller space, forcing a corresponding amount of air out of the lungs when the thoracic capacity is suddenly diminished.

The mediastinal shadow must be displaced toward the opposite side when there is fluid in the pleural sac.

An extensive very dense shadow extending over one entire side of the chest must be due to massive hepatization unless the mediastinal shadow is distinctly and markedly displaced to the opposite side. This is plainly shown by percussion or by the screen or plate. Usually the trachea also may be clearly seen

Fig. 114.—Sept. 8, 1918.—This plate shows distinct absorption of the pleuritic exudate and evidence of the right lower hepatization persisting. On the screen the diaphragm could again be plainly seen.

to be displaced by the latter methods. As mentioned under pneumonia, a shadow at the periphery shading lighter toward the hilus is probably due to fluid, in an adult.

A shadow near the hilus fading toward the periphery is probably hepatization.

A sharp upper line of demarcation of a shadow favors pneumonia (lobar).

By careful observation we can sometimes make out waves in the shadow of the fluid, due to the heart's impulse, when the patient is recumbent and the amount of the fluid not too great. The displacement of the mediastinal shadow is the only sign that indicates the amount of fluid present. Therefore, in plat-

Fig. 115.—Sept. 11, 1918. Patient walked to *x*-ray room in good spirits. Has improved rapidly ever since his crisis. Fluid absorbing rapidly, although not nearly as rapidly as it came. On the screen entire line of right diaphragm seen, also shadow moving in right lower lobe.

ing chests with possible fluid, it is very important to get the entire normal side on the plate so that the displacement of the mediastinal shadow can be better estimated. The accompanying plates illustrate well the need of this.

I wish to mention here with emphasis the value of postmor-

tem examinations by the Roentgen ray when an autopsy cannot be obtained. The only caution necessary is that all orifices of the body be carefully and efficiently closed with cotton tampons.

The information to be obtained by the postmortem use of the aspirating syringe should also be remembered in baffling cases where an autopsy is denied.

Fig. 116.—Sept. 16, 1918. This is a film, as we had no plates. It is one of a stereoscopic pair, however, and plainly showed that the remaining shadow on the lower right was in the substance of the lung. Mediastinal shadow entirely returned to the normal position.

There is no difference in the shadows produced by serous and purulent effusions. The clinical picture and the exploring needle make this differentiation.

In pneumothorax, either with serous fluid or pus, the maintenance of a *horizontal* surface and the demonstration of waves upon this surface by tapping or jarring the chest are well known.

The absence of the traditional physical signs in some cases of pneumothorax is quite remarkable and as yet unexplained.

We noted in 2 cases of right-sided pneumothorax a very definite engorgement of the superficial veins in the upper half of the anterior surface of the chest on the affected side, and a very striking distention of these veins—also confined to the affected side—during coughing. Both these cases also had a definite dysphagia. The unilateral venous distention and the dysphagia both disappeared when the pressure in the pleura was relieved by aspiration.

The use of the *x*-ray after operations for empyema, to determine whether all "pockets" have been drained and to watch the progress of the case, is very important.

If 5 per cent. thorium sulphate solution is used to make the cavity visible it should be injected on the fluoroscopic table and quickly *washed* out, as it is quite irritating and may cause quite a little hemorrhage from the granulating surfaces.

In these pocketed empyemas we sometimes observed a shadow more dense than the liver. They were often at the lateral border of the chest parallel to the spine, but might be along the mediastinal shadow or even anterior to the pericardium. We had one case of pus in the pleura at the right border of the heart which, by fulness, pulsation, and pain, at first suggested aneurysm.

PERICARDITIS

In cases of pericardial effusion we may get a fluoroscopic shadow of characteristic shape and location, and which differs from the shadow of a large heart by the slightness or even absence of visible pulsations, and very often by the fact that we can feel the apex impulse well within the outline of the shadow. This is a valuable guide for the use of the exploring needle. I prefer to explore to the left of the heart, but in one case we were misled here by a pocketed empyema of the pleura bordering upon and overlapping a fairly large serous pericardial effusion.

In the dry stage a pericarditis may cause very severe pain. I recall one case that occurred suddenly without discoverable etiologic relations, was accompanied by loud crackling friction

sounds all over the precordium, required three generous hypos of morphin the first day, and disappeared without leaving a trace within three days. This man had had a chronic nephritis, of which, however, there had been neither sign nor symptom for probably two years.

We must ever keep in mind the possibility that an abscess elsewhere complicating an intrathoracic condition may determine a lethal termination because discovered too late.

I can mention three regretable cases from my own observation: A pericecal abscess, an empyema of the knee (which was thought to be a simple serous arthritis), and a subhepatic abscess. Beware of these conditions after operations for retrocecal appendicitis which is followed by pneumonia. Although the pneumonia may be definite, ask yourself if it accounts for the entire picture.

EMPYEMA AT CAMP DODGE[1]

By Lieut.-Col. Joseph L. Miller, M. C., U. S. A., and
Captain Frank B. Lusk, M. C., U. S. A.

September 26, 1918.

During the year preceding September 20, 1918, approximately 800 cases of pneumonia were treated at the Base Hospital. Of this number, 276 cases from the opening of the camp to March 20, 1918, were chiefly lobar pneumonias due to the pneumococcus. From this date until June 1st 464 cases were treated, chiefly lobular in type, and due to the streptococcus. From June 1st to September 1st the pneumococcus form again predominated. This discussion is confined to pneumonia and empyema prior to June 1st.

Among the 276 cases of pneumonia prior to the streptococcus epidemic empyema appeared as a complication in 17.4 per cent. Its frequency showed a progressive increase—October, 2.3 per cent.; November, 12.2 per cent.; December, 17.3 per cent.; January, 27.9 per cent.; February, 24.5 per cent. With the appearance of the streptococcus infections in March the incidence of empyema rose to 42.5 per cent., falling to 29.5 per cent. in April and to 22.4 per cent. in May. With the exception of the first few weeks of the epidemic empyema was, therefore, not more frequent as a complication than it had been in the preceding months.

The monthly number of pneumonia patients entering the hospital from October 1st to March 1st varied from 39 to 58. As shown by these figures, at no time during this period was there a real epidemic. During March the number rose to 165; April, 242; May, 103, dropping down to 24 in June.

[1] A report on this same subject was made at the meeting of the Amer. Med. Assoc. in June, 1918. At that time complete statistics were not available. Any difference in figures in the two reports can be explained on this basis.

The type of empyema was the same in the period preceding the epidemic as it was during the epidemic. Comment was made early in the winter upon the presence of pus pockets, the difficulty in making the diagnosis, and the unfavorable terminations. On account of the incompleteness of the bacteriologic examination it is impossible to say whether many of these may not have been streptococcus infections, although the laboratory reports on the sputum during this period showed only infrequently the presence of the streptococcus, and the pathologist reported a lobar pneumonia type.

The treatment of this group of so-called pneumococcus empyemas was early rib resections and drainage. The mortality in 40 cases was 52.5 per cent. Inasmuch as 8 of these were not operated upon either because the complication was not recognized during life or the condition of the patient rendered operation inadvisable, only 32.5 per cent. of those operated upon died. In those dying after operation undrained pus pockets were frequently found.

With the advent of the streptococcus epidemic empyema not only became more frequent, but appeared very early, and a fatal termination was reached much sooner than in ordinary empyemas. Two patients with well-developed empyema had drilled two days previous. Empyema was never observed except as a complication of a definite pneumonia, although the lung involvement was not necessarily extensive. In the 109 cases coming to autopsy, bronchopneumonia, either alone or combined with lobar pneumonia, was present in 78, or 71.5 per cent. Clinically it was often exceedingly difficult, especially in the confluent forms, to determine whether the process was lobar or lobular. In 53 of the 109 cases where the diagnosis of lobar pneumonia was made, autopsy showed a bronchopneumonia.

Bronchitis was the most frequent premonitary manifestation. This was noted on the records in 122 cases; next in frequency was sore throat, recorded 65 times. There were, however, many cases where, from apparently good health, the onset was ushered in by a chill. Only 24 cases followed measles.

Acute abdominal pain was noted eleven times and was frequently most difficult to differentiate from appendicitis. An immediate *x*-ray was often of value, although not infrequently observation for several hours was required in order to establish a diagnosis.

The colored soldiers, while more susceptible to pneumonia, were less susceptible to empyema. At the time of the outbreak of this epidemic there was one full regiment of colored troops from Alabama in camp, having entered in October. March 29th, in the midst of the epidemic, 2900 colored troops from Tennessee were received.

Of all streptococcus pneumonias, 32.3 per cent. developed empyema. Among the white troops it developed in 42 per cent., and in 26 per cent. of the colored pneumonias. The mortality in the colored was 40 per cent. and in the whites 60 per cent. Suppurative processes elsewhere were also less frequent, as suppurative pericarditis occurred only twice in colored soldiers. On the other hand, 19.9 per cent. of colored uncomplicated pneumonias terminated fatally, compared with 10.7 per cent. of the whites.

Apparently the epidemic first appeared among the colored troops. Forty-one of the first 100 cases came from this single regiment, which represented about one-sixth of the total strength of the division. The three other infantry regiments had 17, 14, and 7 cases each. However, the white regiments were not full strength, the total number in the three being approximately 6500; while the colored regiment had slightly over 3600. Studied by companies, these first 100 cases were about equally distributed, no one company showing a marked prèponderance of cases. From November 1st to February 23d no large body of new troops entered camp; beginning on this latter date 15,000 northern white soldiers were received. Beginning March 29th 2400 whites and 2600 colored (the latter chiefly from Tennessee); April 26th 10,000 more white troops were received. These were the chief changes preceding and during the epidemic which appeared about March 20th.

Many observers have already called attention to the diag-

nostic difficulties offered in the detection of these pus pockets. The findings at autopsies demonstrated how difficult or perhaps impossible it would be for the clinician to locate these. Even large amounts of free pus, especially early in the epidemic, were overlooked by the medical officers. In some cases it would probably be explained by the rapid accumulation of fluid during the last few hours of life. In others the physical findings were those of a complete or partially consolidated lung, although aspiration demonstrated the presence of an exudate. Apparently no adequate explanation has been made of these misleading physical findings. The *x*-ray when frequently repeated was of considerable value. The chief reliance, however, was placed upon the character or long continuation of the fever, and the frequent and repeated resort to exploratory puncture. In spite of these various measures, and although the ward surgeon in many cases was practically certain that pus was present, it was not located until autopsy. In 109 empyemas coming to autopsy, undetected pockets of free pus, not recognized clinically, were found in 41 cases. In 18 of these the amount of pus was so small or so deeply located that its recognition would have been extremely difficult. Comparatively large collections of pus were overlooked in 23 cases. On 109 empyemas autopsied, the right side was involved in 37; the left, 42; bilateral, 27, and poststernal alone in 3.

Exudative pericarditis was found at autopsy 38 times, or in 34.8 per cent. In 17 of these the fluid was definitely purulent. Exudative pericarditis was only found in association with empyema. The empyema was right-sided in 11, left in 16, and bilateral in 11. As previously stated, exudative pericarditis occurred only twice in colored soldiers.

Peritonitis was present in 17 of the 109 empyemas coming to autopsy. It was never present except in association with empyema. The latter was right-sided in 8, left in 5, and bilaterial in 4. In 6 of the 17 cases there was a combination of peritonitis, pericarditis, and empyema.

Other complications occurring infrequently were: arthritis 8 times, with 4 recoveries; erysipelas 5 times, with 2 recoveries;

acute endocarditis and gangrene of the lung was only found once; suppurative otitis media was quite common, but exact figures are not available.

The mortality in the 164 empyemas developing during the streptococcus epidemic was 61.7 per cent. The combined mortality from uncomplicated pneumonia and empyema was 31.7 per cent.

At the onset of the epidemic, immediately on the detection of a turbid fluid containing streptococci, drainage by rib resection was performed. The results were not satisfactory. Many patients returned from the operating room in a state of collapse from which they did not recover. In their extreme toxic condition, apparently the shock of the operation, and especially the effect on the heart of the artificial pneumothorax was sufficient to at least hasten a fatal termination. After employing this method of treatment for about ten days a change was made to repeated aspirations until the condition of the patient was sufficiently improved to warrant operation. The results from this procedure appeared to be much better; in fact, the improvement was so marked in some of these cases after a few aspirations that operation was delayed, and in 11 cases recovery without operation resulted. It is interesting to note that 6 of these were aspirated only once. It is possible and perhaps probable that these would have recovered without aspiration.

When we compare the mortality results of these various measures, it is found that in 43 cases with early operation 52.5 per cent. died. In 49, with repeated aspirations, then operation, the mortality was 32.5 per cent. In 24 cases where aspiration alone was performed, either because the improvement was so marked that an operation was not considered necessary (this was true in 5 cases) or on account of the gravity of the condition was considered unfit for operation, the mortality was 73.6 per cent. In addition, there was a fourth group of 32 patients who were only aspirated once. Six of these were mild cases, where recovery followed a single aspiration. The others were very grave cases, where death occurred before repeated aspiration or operative measures could be carried out. The mortality

here was 81.2 per cent., or all died except the 6 mild cases referred to. As previously stated, the mortality in all cases of empyema during the epidemic was 61.7 per cent.

One point should be considered in regard to these figures: viz., that apparently the virulence of the infection was more marked early in the epidemic. Immediate operative measures were undertaken at the onset of the epidemic, and the mortality during this period was 76 per cent., while immediate operation in May gave a mortality of 28.6 per cent.

Repeated aspiration followed by operation was begun about the beginning of the third week of the epidemic, with a mortality of 39.3 per cent., falling to 28 in May. As seen from these figures, the results of these two procedures were the same in May when the epidemic was dying out. If repeated aspiration followed by operation had been instituted at the beginning of the epidemic it is highly probable that the mortality would still have remained very high, as it was the opinion of the medical officers after the first two weeks that the virulence of the infection was distinctly reduced.

SUBACUTE AND CHRONIC MEDIASTINAL COMPLICATIONS OF MEASLES

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The acute complications of measles, the bronchopneumonias and empyemas, the sacculated pus formations, found generally at necropsy in the mediastinal region have been frequently enough described in recent literature. The later results of the infection have not been so thoroughly recorded. Among the latter persistent tachycardias (neurocirculatory asthenia?) are worthy of note, and also the type of case to be recorded here.

The first patient, A., twenty-five years of age, a private in an infantry regiment, was admitted to the Base Hospital April 1st. He had had more or less of a cough for some time previous to admission. There had not been anything urgent about this condition and he had not sought treatment for it. His complaint on admission was of a neuralgic pain in the right lower chest quite constantly present, but made distinctly worse on cough and deep inspiration. It was also more severe during the night. This had been present for four days and had been increasing in severity. He felt rather feverish in the afternoon. He had had no night-sweats. The patient is a farmer and denies the use of alcohol. He is unmarried. He had typhoid fever fifteen years ago. Two years ago he had pneumonia and was laid up for two months with it. There is no history of venereal disease. The family history is negative as to pulmonary disease.

On admission he had a few coarse râles at the base of the right lung and moderate right apical fibrosis. The temperature on the first day was 101° F. On the fifth day after admission he developed a typical measles rash. On April 7th the tempera-

ture fell suddenly to normal, where it remained for a week, but the chest signs persisted and, in fact, increased. In addition to the bilateral so-called indeterminate râles there appeared fine moist râles distributed in patches. On April 15th he suffered an increase in his pulmonary signs which had nearly cleared up, and a recrudescence of his fever. The leukocyte count rose to 26,000 and a diagnosis of bronchopneumonia was made. During the next twenty-seven days he ran a low grade temperature, with an occasional normal day.

At this point let us discuss in further detail one of the earlier observations made in this patient, namely, his cough previous to entrance. Whether or not this had an etiologic relationship to his bronchopneumonia is a difficult matter to decide. Does a bronchitis, head cold, sinusitis, or postnasal catarrh present before the onset of the measles prodromata predispose the patient to a subsequent bronchopneumonia? Captain Schnabel, who has been interested in this phase of the pneumonia problem, tells us that of 333 patients with measles and bronchopneumonia 55 gave a history of cough, cold, or other respiratory tract infection previous to the onset of the measles prodromata, while of 333 uncomplicated measles cases only 14 gave a similar history. It would thus appear possible that preceding infection predisposes to bronchopneumonia.

We are told from other camps, particularly Funston, Taylor, and Fort Sam Houston, that postmeasles pneumonia occurs as a result of infection with Streptococcus hemolyticus, and that if this organism is not present bronchopneumonia is not likely to occur. The man before you has not been infected with Streptococcus hemolyticus. The prevailing organism in his sputum is a Type IV pneumococcus which has been recovered repeatedly therefrom. The great majority of our pneumonias have been infected with Type IV pneumococcus. Moreover, we have had but two or three cases of Streptococcus hemolyticus pneumonia in this hospital.

Our patient, then, after an attack of measles developed later a bronchopneumonia, and toward the end of the month a new complaint. This consisted of a pain in his left side, increased

on inspiration and more recently localized also under the manubrium. It is worse on deep inspiration. There is some orthopnea, considerable cough, not harsh or brassy, and with but little expectoration. The hemoglobin is 65 per cent., the red count 4,440,000. The right pupil is definitely larger than the left and both react normally to light and accommodation. The chest shows nothing particular on inspection other than some dilatation of the cutaneous veins over the manubrium and in the left axilla. The heart findings are of some importance. Two days ago the apex impulse could be felt in the fourth intercostal space just to the right of the sternum. Today it can but barely be felt in this locality. The point of maximum transmission of the heart sounds is to the right of the sternum. Percussion of the cardiac outline shows the left border to be 3 cm. inside the left nipple line and the right border 3 cm. to the right of the midsternal line. The heart is moderately accelerated, ranging from 90 to 100 beats per minute. It is regular. The sounds are of good quality and there are no murmurs or other abnormal sounds either at the apex or at the base.

At the base the retrosternal dulness is distinctly increased to the left. It measures 8 cm. in each of the first, second, and third interspaces. No murmurs are heard. There is neither thrill nor diastolic shock present. The pulses are decidedly unequal, the right being fuller than the left, and at times there is some delay in transmission of the pulse to the left wrist. In the right arm the systolic blood-pressure is 110 mm. Hg., the diastolic 90. In the left they are 100 and 78 respectively.

On examining the lungs we find at the right apex the same signs of moderate pulmonary fibrosis that were present on admission. There is also definite impairment in the left apex behind down to the spine of the scapula. Breath sounds are transmitted normally throughout the right chest, but are diminished, almost suppressed, throughout the left lung from apex to base. There is no impairment of resonance to percussion at either base and no evidence of fluid accumulation. No râles are heard today in any portion of the chest, not even after coughing.

The patient is still running some temperature. Last night it went to 104° F., the highest that it has been in some time. He sweats every night. The white count varies from 15,000 to 24,000 and the polymorphonuclear from 73 to 80 per cent. No tubercle bacilli have been found on any of four examinations. Routine stool examination for hookworm was negative.

Fig. 117.

We have, then, as signs of pathology in the mediastinum increased dulness, unequal pupils and pulses, asynchronous pulses, dilatation of cutaneous veins, and non-productive cough. There is no evidence of aneurysm. No murmur, shock, thrill, or tracheal tug. The Wassermann reaction is negative. The condition, whatever it may be, is relatively acute. There is no adenopathy in other regions. With this process we have as-

sociated the constitutional signs of pus, a septic temperature, sweating at night, leukocytosis, and an anemia.

This case is presented as one of subacute suppurative mediastinitis following measles and bronchopneumonia. The other possible condition present would be a small pocket of pus present in the pleura between the lung and mediastinum.

Fig. 118.

x-Ray examination is as follows. The first plate (Fig. 117) was taken shortly after admission to the hospital.

"April 4, 1918: Plate shows some thickening of the hilus shadows, through which are scattered dense round shadows varying from 2 to 8 mm. in diameter, probably old calcified tuberculous lesions. Both apices are somewhat cloudy, with increased linear markings extending thereto. Near the right

base there is a large area of dense shadow extending to the diaphragm and apparently involving the diaphragm in adhesions. This shadowing gives the impression of dense fibroid thickening. The findings in this patient are believed to be due to an old tuberculosis, present activity undetermined" (Fig. 118).

"April 23, 1918: Right apex clear. Mottling of the right lower lobe, which also presents a homogeneous hazy shadow. Entire left lung cloudy. Small areas of dense consolidation at lower left cardiodiaphragmatic angle about the size of an egg. Mediastinal shadow enlarged, giving the impression of a dilated aorta. Impression, generalized bronchopneumonia."

Three physical signs remain to be accounted for. First, the suppression of the breath sounds in the left lung in spite of good percussion resonance; second, the impairment at the left apex; third, the displacement of the heart. The first condition is probably due to pressure on the left bronchus. The apical dulness is a result of decrease in air-containing tissue due to the enlargement of the upper mediastinal tissues to the left. The cardiac displacement is not entirely satisfactorily explained. The next *x*-ray offers an explanation.

"May 9, 1918: Plate shows apices somewhat cloudy and costophrenic angles clear. The pneumonic process previously described in its base has undergone some resolution. The heart and mediastinal vascular shadows are displaced slightly more to the right than was shown on the previous examination. The inner half of the parenchyma of the left lung and left hilus are obscured by a dense homogeneous shadow, which is greater in area than shown on last examination. Impression, pleural thickening and fluid in the pleural cavity at the inner border of base of left lung which has rotated and displaced the heart to the right" (Fig. 119).

If this is the true condition, the diagnosis of acute mediastinitis is in error. The *x*-ray diagnosis is, however, not absolute. We have had a couple of other cases with loculated empyema next to the mediastinum. This might appropriately be called juxtamediastinal empyema or juxtamediastinal pus. These others did not give pain as the chief symptom. Our man here

complained chiefly of pain, and the distribution is characteristic of that found in acute mediastinitis where it occurs under the sternum and radiates into either shoulder. It may be influenced by change of position.

In any event, the treatment is the same. We shall continue with supportive treatment. Needling is contraindicated at the present time. We will take repeated *x*-rays, and as long as the

Fig. 119.

patient continues in good condition will wait until the pus becomes well encapsulated or an abscess forms. Then will be time enough to consider drainage. Surgical interference in the mediastinum should not be sought at the first opportunity. Of course, if he gets worse we will needle him, going in behind in about the fifth interspace with a small needle and near to the spinal column, in the hope that we are dealing with a juxtamediastinal empyema.

"July 8, 1918: The general condition of patient A. continued to improve, although night-sweats continued for over two weeks and a half. The temperature has been normal for many days at a time. It has not risen over 99.6° F. for over five weeks, except one week, when he developed a tenosynovitis of the right knee."

Fig. 120.

x-Rays have been as follows—May 21, 1918: Left apex cloudy and right apex nearly clear. All angles clear. There is increase in each hilus shadow and mediastinal vascular shadows. There is an increase in bronchial tracings radiating through parenchyma of both lungs. There is a dense shadow homogeneous in character obscuring partially the left hilus. This plate compared with the plate made May 9, 1918, shows that resolution has taken place to a considerable degree in both right and left lung, and shows the mediastinal shadows to be less in width.

The heart appears either rotated or pulled to the right. It lies in the midline of the thorax. The stomach is distended with gas to an unusual degree (Fig. 120).

"June 19, 1918: Both apices fairly clear. All angles clear. Numerous pea-sized calcified areas seen in the region of each hilus, and a few also in the parenchyma of each lung. Marked increase in bronchial tracings radiating throughout both lungs.

Fig. 121.

Impression, pneumonic residue. Evidence of past lesion, probably tuberculous, which is inactive at this time. Marked fibrous change seen throughout both lungs" (Fig. 121).

The patient has been up and around for some time and feels well. He does not raise sputum, and he was transferred today to a general hospital.

The second patient, B., an infantryman, twenty-three years

of age, white, entered the Base Hospital on June 21, 1918. In civil life he had been a farmer. His habits have been good, and the family history is of no importance except for the fact that one brother has tuberculosis (?) of the left arm and leg. The patient denies venereal infection. He has had whooping-cough and diphtheria in childhood. He was in this hospital in December, 1917, with measles. In January of 1918 he had an attack of mumps. He has been coughing more or less since the measles attack of last December. In March, 1918, he had an attack of some kind with fever, cough, expectoration, and hoarseness. The sputum was not excessive, but thick, tenacious, and never bloody. During the severe attack in March he had epigastric pain and vomited freely. The patient's appetite has been fair, but he suffers from rather frequent night-sweats. He claims to have lost in all about 40 pounds in weight. At present he complains of some pain under the sternum and in the left axilla and is nauseated at times.

Examination reveals a tall, rather poorly nourished, but fairly well built young man who appears pale and weak. The pupils are regular, equal, and react normally to light and accommodation. There is an enlarged gland in the right supraclavicular fossa, hard, elastic, movable, not tender, and about the size of a small walnut. There are several similar but smaller glands in each of the axillæ. There is no evident adenopathy elsewhere in the supraclavicular region. The pulse is regular, rate 160 standing and 120 lying down. The radial pulses on the two sides are equal. The systolic blood-pressure measures 100 mm. Hg., the diastolic 75. Both sides of the chest expand equally. There are no abnormal pulsations in the chest and no distended veins are visible. There is some depression of the supraclavicular fossæ. In both apices there is found dulness, bronchovesicular breathing, and changes in the whispered voice sounds as far down as the second interspace anteriorly and to the tops of the scapulæ posteriorly. Krönig's isthmus is fairly wide and equal at both apices. No râles are audible.

The apex-beat of the heart is diffuse, in the fifth interspace at the nipple line. The transverse diameter of the heart meas-

ures 13.5 cm. There are no thrills, murmurs, or accentuations. There is some dulness on percussion over the manubrium extending a short distance to either side. The abdomen is scaphoid. There is no tenderness and no masses in the abdomen. The liver and spleen are just palpable. Tendon reflexes are normal.

Examination of the larynx by Major Fetterolf showed a paralysis of the left vocal cord which accounts for the patient's persistent hoarseness.

An *x*-ray of the chest, taken shortly after admission to the hospital:

"Both apices mottled. All angles fairly clear. Hilus shadows increased. There is a soft, moist, flaky mottling through the upper two-thirds of the left parenchyma. Similar shadowing in the right parenchyma, though less in degree. Between the second and third interspaces anteriorly and just to the right of the spine is a dense homogeneous shadow, $5\frac{1}{2}$ cm. long and $1\frac{1}{2}$ cm. wide. In the stereoscope this shadow appears to be posterior to the mediastinal vascular shadow and at the inner border of the right larynx above the hilus. *x*-Ray diagnosis (Captain Hawkins): The shadow is probably caused by the thickened pleura at this location. The lung changes probably indicate pneumonic residue" (Fig. 122).

The gastric analysis, after a test-meal, showed nothing abnormal. The Wassermann reaction was negative. No tubercle bacilli could be found in the sputum. The patient's red count is 4,800,000, the leukocytes 7000. The differential count shows 8 per cent. of large mononuclears, 24 per cent. of small mononuclears, and 68 per cent. of polynuclear cells. His hemoglobin is 68 per cent.

The patient's supraclavicular gland has become decidedly larger since admission. On the whole, he feels fairly well, but somewhat weak. He has an afternoon temperature of 99° to 99.6° F. and coughs considerably at night, but is improving in his general condition. An *x*-ray of the gastro-intestinal tract has revealed no abnormalities.

The diagnosis as to the gross pathologic condition is, of

course, simple. There is pressure on the left recurrent laryngeal nerve. Aneurysm and malignancy are ruled out by the clinical and *x*-ray evidence. The suggestion of the radiologist that the mediastinal dulness might be due to a thickened pleura following the measles or an overlooked localized empyema is rendered improbable by the signs of present activity, temperature, pain, and variation in size in the supraclavicular gland. The only

Fig. 122.

other possible explanation is pressure from enlarged glands. This, of course, accounts for the pressure symptoms, and the fact that it follows measles makes us incline to the belief that it is a simple or tubercular localized adenitis of the peribronchial lymph-glands rather than a beginning Hodgkin's disease. The evidence is not sufficient to diagnose a tubercular adenitis stirred up by the measles, though the suggestive family history, the absence of leukocytosis, and the night-sweats might argue in

favor of that. A simple chronic infection would give the same clinical features.

We do not consider removal of the deep cervical gland advisable at the present time because of the patient's evident improvement.

"September 19, 1918: The patient B. has improved slightly up to the present time, although there has been no great change

Fig. 123.

in the clinical condition. The hoarseness has persisted. The temperature has been normal or essentially so since July 5th, with the exception of the very frequent afternoon rises to 99° or 99.6° F. up until August 27th. For a week he then ran an afternoon temperature up to 102° F., with normal morning readings. Since that time both morning and evening temperatures have been normal. The *x*-ray taken at the beginning of this last febrile period was described as follows:

"August 26, 1918: There is a soft, flaky mottling, radiating into the apices through the upper two-thirds of each parenchyma. The shadowing is slightly more marked on the right side. Impression, active pulmonary tuberculosis" (Fig. 123).

At the time of discharge it is noted that the gland above the right clavicle is slightly larger and that the lung shows no signs of activity other than a few crepitant inspiratory râles in the left lower back and axilla. Otherwise the chest findings are as previously noted. The evidence at hand appears to favor the diagnosis of a lighting up of an old tuberculous activity.

The patient was transferred today to a general hospital.

We have presented the first case because it afforded an unusual opportunity for following a subacute mediastinitis or juxtamediastinal collection of pus. This second case we present to show the remote results of measles. There are two points we wish to emphasize: first, the very evident rapidity of the pulse on entrance, which continues, though slightly less marked, at the present time. We explain it readily by his slight temperature and the toxemia from the infection of the deep glands. The tachycardia might favor a diagnosis of tuberculous adenitis. Had we found an enlarged thyroid we would have, perhaps, accounted for it on that basis. Had it persisted for some time and a few minor symptoms, such as cyanosis of the extremities, some tremor, etc., been added, and if none of the above causes had been determined, we would have classed this man as a case of neurocirculatory asthenia. It is one of the striking after-effects of measles, at least in adults, that with a temperature that may last only three or four days a tachycardia will so often persist as many weeks or longer, together with perfectly normal subjective condition, or at most a slight feeling of weakness. Whether this may be due in any particular case to myocardial changes or to changes in the specialized tissue of the pace-maker, or to pressure or toxemia from enlarged peribronchial glands, we cannot say except in very pronounced cases such as the present. But we believe that these two patients offer possibilities in the etiologic factors of the effort syndrome which are not being sufficiently considered.

Furthermore, it seems reasonable to suppose that the same toxemia from the infected glands which produced the tachycardia will produce in the adolescent body every nervous and vascular symptom of the effort syndrome. We believe, then, with those who hold that the effort syndrome or neurocirculatory asthenia means in the majority of cases a slightly damaged heart, following an attack of measles or some other infection. Another point which we wish to bring out is the very slow subsidence of inflammatory processes in the deep glands. When a pharyngitis subsides for a day or two and a recrudescence then takes place, generally one of two things has happened—either we have a direct extension along the mucosa to the larynx, etc., or an extension along the deep cervical glands to those of the chest, and it is these which by pressure cause cough without lung signs and generalized toxic effects. This is a type of focal infection, namely, of the deep glands, the existence of which is not often taken into consideration. The nose and throat, the teeth, the prostate, and the uterus are examined because they are accessible, but the deep glands as a cause of chronic systemic disturbance are not sufficiently often thought of. A search for them or even the consideration of the possibility of their existence would probably save some innocent teeth and tonsils.

COMMENTS ON THE METHODS EMPLOYED IN PREVENTING MEASLES COMPLICATIONS

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Contrary to past experience in army camps, measles complications have taken the first place as the most dreaded of the mass infections, and naturally the first question raised has been as to the possibility of preventing the spread of the primary disease. That the necessarily rather crude methods available in camps materially limit the extent of measles epidemics has not, we think, been shown. Quarantining of recruits is not logical, for, aside from the mild missed cases turned loose at the end of the quarantine period, those who become infected in the last few days of the isolation will develop the disease after release, and so the epidemic spreads until its virulence is below a certain threshold of infectivity, or the amount of susceptible material is exhausted. Other methods of prophylaxis have not, to our knowledge, been employed. The use of serum from measles convalescents, for example, might have such value.

Statistics as to the suggested use of streptococcus vaccine in measles patients are not yet available. If, however, it is true that streptococcus and pneumococcus pneumonia and empyema are the results of secondary throat infections, and if in measles such throat infections are not acquired at the outset, but later in the course of the disease, then we may hope to accomplish something by the only other practicable prophylactic measure, that is, the separation of measles patients from each other

Inasmuch as Base Hospitals can control the patients only from the time that they are received in the hospital, the success of the isolation depends on the percentage of such infections

acquired after their entrance into the hospital. Cole and McCallum report that only 11.4 per cent. of their measles cases on entrance gave positive streptococcus throat cultures, which number after one to two weeks' stay in the wards rose to 56.8 per cent. Cumming, Spruit, and Lynch found about 35 per cent. of measles cases to be streptococcus carriers, while Levy and Alexander found 77.1 per cent. carriers on admission. Remembering that an error of 25 per cent. is possible when the conclusions are based on one throat culture only, these variations may perhaps be due to this fact as well as to local differences in the epidemics.

The two latter groups of investigators recommend that all new measles patients be held in one section of the ward until they are identified as clean cases or as carriers, and that they then be segregated. As such identification requires at least eighteen hours, such a method certainly carries with it danger of cross infection during that period. That there is some flaw in our present methods is evident from the work of Levy and Alexander. Segregation as above indicated, using the ordinary means advocated, such as hanging sheets between the beds, masking all attendants, policing the floors, etc., were found by them to be insufficient. In one ward with 15 clean cases, that is, cases with no streptococci in the throat cultures at entrance, and 15 contaminated cases of measles, they found at the end of one week only 6 non-carriers remaining. In another ward of 24 of whom, at the beginning, half were clean and half were carriers, at the end of a week only 3 clean cases remained. Such isolation measures are evidently at fault somewhere.

In deciding on any scheme for isolation we must consider the following possibilities: (1) air-borne infection, distant and near; (2) infection by carriers and by missed cases; (3) infection by contact, either direct or indirect. In the schemes for the prevention of crossed infection in measles so far proposed the first factor enumerated has been reasonably carefully guarded against, the second and part of the third fairly well considered, and the prevention of infection by indirect contact comparatively ignored.

The apparent importance and the demonstrated importance

of these three factors appear to be quite different. Thus the transmission of infection through the air for long distances is now recognized as negligible. The expired air in quiet breathing does not contain bacteria. Only on loud talking, sneezing, and coughing is the air infected, and then it is through droplets of saliva or of sputum of various sizes, the larger droplets which contain by far the largest number of bacteria being carried only short distances, while the smaller droplets, which contain fewer, may be carried to a distance of many feet in all directions. In general, it may be stated that the danger zone is not greater than from 3 to 9 feet around the patient. Infections occurring along a greater radius than this, as, for instance, from one family to another in the same house, are usually traceable to contact infection.

Infection by carriers does not concern us greatly here. It is brought only where nurses or convalescents harbor streptococci in their throats, and presumably the gauze masks are sufficient protection against this. The proof, however, is so far purely empiric. We know of no experimental facts to determine the number of layers of gauze or the fineness of the weave needed to sterilize the air in coughing or sneezing. Infection by direct contact is insured against by keeping the patients apart, but it is the indirect transfer which is so generally overlooked.

This method, to which Grancher and his followers called attention over twenty-five years ago, is in need of greater consideration at the present time. It practically narrows down to the transfer by physicians, nurses, and ward men of infected material by their hands, clothing, or utensils. It is evident that in the case of meningococci such transfer must be rapid, as this organism is visible for short periods only outside the living body, but streptococci, with their greater resistance to drying, may carry infection after much longer periods. It has also been demonstrated that pneumococci in dried sputum may live as long as one month. In order to prevent such transfer the principle would have to be adopted of sterilizing every object before it touches the patient and every object which is carried away from him. Infection is carried to the mouth not only by

respiration, but probably to a much greater extent by the hands of the patient from his clothes, body, etc. To have a nurse's gown sprayed with sputum while bathing one patient, and then to bathe a second whose hand will quite certainly come into contact with the gown, and subsequently with his lips or nostrils, is surely a possible source of cross infection. The same applies to the basin used in bathing the patient and (what is less frequently considered) to the bed-pan and urinal. Of course, no one would use a thermometer on a second patient without at least the ceremony of disinfection, although the effectiveness of the same is certainly doubtful in many instances. In short, if we wish to avoid cross infection from streptococcus carriers to non-carriers we must isolate each measles patient from every other with the same care that we would use in isolating a scarlet fever from a measles case.

To accomplish this it is necessary to separate the cubicles more effectually than by the sheet method. One has only to see the sheets blown about by the wind or pulled aside by the patients in an attempt to relieve their loneliness to realize their inadequacy. In an attempt to improve on this system we have had light screens constructed consisting of wooden frames, 8 feet long and $6\frac{1}{2}$ feet high, made of 2-inch strips. The foot-rest is 18 inches wide, just enough to furnish adequate support. On the frame is stretched a large sheet of canvas, salvaged from tentage and painted white. It is kept flat by light diagonal wooden strips one on either side. One of the screens is placed on either side of the bed, backed up close to the wall, while along the free ends runs a wire for attaching the sheet, which forms the fourth wall of the cubicle. In very hot weather or after coughing has ceased the sheet may be partially drawn back. The advantage of such a miniature room is not only in the diminution of the danger of droplet infection, but in the increased tendency on the part of the personnel to obey the many rules for isolation.

Were such a course possible the proper method of preventing transfer of infectious material would be to have a separate and complete outfit for each patient, from bed-pan to thermometer,

including stethoscope, and to require the use of rubber gloves in handling patients. As this is obviously not feasible, we have adopted rules carrying out the principles stated above, of which the following were the most important:

> "Isolated patients shall be confined to the cubicles until considered safe by the ward surgeon." (This would logically be decided by the throat cultures.)
>
> "A gown shall be permanently kept in each cubicle and must be worn by every individual who enters this space except when there is no actual contact with the patient or the bed.
>
> "Individual thermometers, wash cloths, basins, towels, and glasses must be kept in each cubicle.
>
> "All dishes must be soaked in lye solution and then in hot water.
>
> "Bed-pans and urinals shall be washed in water immediately after being used, and then placed in a large galvanized iron can containing lysol solution for at least one-half hour before being used again.
>
> "Medicine glasses, syringes, and ice-bags must be thoroughly sterilized after each use.
>
> "Water-taps and basins in bath-rooms should be frequently washed with lysol solution."
>
> Finally, "Any individual handling patients must wash his hands in lysol solution after touching a patient or any article which has come in contact with him."

The remaining rules were the usual ones in force in contagious wards.

Of course, such a régime necessitated a slightly more numerous personnel, but, above all, a more constant one. Frequent changes are inimical to any success in handling contagious diseases. But it is possible that the lack of such detailed care is at the bottom of the failure of the ordinary methods of isolation.

A further advantage of the isolation of every case is that preliminary throat culture is rendered unnecessary and the dangers arising even from eighteen- to twenty-four-hour contact of clean with dirty cases are avoided. Furthermore, in the case of a mistaken diagnosis a patient may be withdrawn from such a cubicle, if the rules have been observed, without having been exposed to measles, though points of contact at time of entrance and discharge from the hospital and from the ward must be looked for and eliminated. It is a question of eternal and intelligent

vigilance. Of course, a minor blunder nullifies an enormous amount of painstaking care.

The only opportunity that we have had of testing the results of this application of Grancher's medical antisepsis was in the early summer. The measles cases increased considerably with the influx of new troops, but bronchopneumonia was so infrequent that reliable statistics could not be obtained. We did, however, take throat cultures of cases within and without the cubicles at intervals, for comparison. Cultures from 20 patients kept in isolation as strict as possible gave the following results:

Twelve, or 60 per cent., had pneumococcus Type IV at entrance. Three more, or 15 per cent., had Type IV at second or third culture, which were taken at five-day intervals, but not at entrance. Eleven, or 55 per cent., had Type IV on two or more cultures. Pneumococcus Type I was found twice. Streptococcus, hemolytic or non-hemolytic, was found on entrance three times, or in 15 per cent. On second or third culture two more, or 10 per cent., were positive. No complications occurred among these patients. These do not, of course, include by any means all the patients kept in cubicles, but only those from whom we took the routine cultures described. As a matter of fact, there was a case of bronchopneumonia in a cubicle patient, but not of this group.

Single or multiple cultures at five-day intervals were taken from patients in the open ward, separated by sheets, in 28 cases. Of these at entrance, 18, or 71 per cent., showed pneumococcus Type IV. Of 12 cases of which three or more cultures were taken at five-day intervals, Type IV pneumococcus was found in 8, or 67 per cent. On second or third culture but not on first it was found twice more, or in 16 per cent. Streptococci were not found at entrance in any of these 12 cases, but were found on second or third culture three times, or in 25 per cent. Complications occurred six times, or in 21 per cent., of the whole 28 cases, including 1 tonsillitis, 4 otitis medias, and 1 bronchopneumonia.

As stated above, the series is not large enough to warrant conclusions. Worth noting is the small number of streptococcus

carriers, which corresponds with the fact that in the severe winter epidemic at this camp the pneumonias and empyemas were not due, as a rule, to streptococcus, but generally to pneumococcus, contrary to the experience in many camps, The question, then, of the value of medical antisepsis in preventing measles complications cannot be answered, but we did find that it does not involve impossible demands on either personnel or property, though calling for a slight increase in number of the former.

Another very pressing need was answered by such movable cubicles, and that was for isolation rooms for suspects of various sorts in times of epidemics. By having extra cubicles in each general ward we were able to isolate every fever case sent in until the diagnosis was established, when, if the above precautions had been observed, the patient could either be moved into the ward or sent to a contagious ward. The danger to the hospital and to the patient is less than in an observation ward as ordinarily conducted.

CONCLUSIONS

1. At present in considering the prevention of measles complications, while emphasis is rightly laid on direct transmission through droplet infection, the indirect means, through attendants, utensils, etc., is being unduly neglected.

2. A more complete method of isolation, that of Grancher, adapted to military needs, has been tried, and while no statistical proof can be adduced, there seems to be a diminished number of complications in the properly isolated case.

3. These screens can also be used to advantage in doubtful cases of contagious disease in general medical wards.

PNEUMONIA AND EMPYEMA AT CAMP UPTON, N. Y.

By Major Russell L. Cecil, M. C., U. S. A.

During the past year the chief medical problem in the American army has been pneumonia. The collection into crowded tents and barracks of large bodies of men, many of whom were in poor physical condition, furnished excellent opportunity for the dissemination of various infectious diseases. First came the commoner contagious diseases, such as measles, mumps, and German measles, and it was soon observed that recruits from country districts were more susceptible to these infections than men from the city. This was particularly true in the case of the pneumonia which often followed measles. The men who composed the 77th Division at Camp Upton were drafted in great part from cities, and proved no exception to the rule that city men endure the overcrowding and exposure incident to camp life better than men from the country and smaller towns.

In any discussion of pneumonia as seen in the American cantonments it is necessary at the outset to differentiate the disease into two types, which might almost be said to be two different diseases, namely, lobar pneumonia, usually of pneumococcus origin, and bronchopneumonia, usually of streptococcus origin. Lobar pneumonia in the camps has differed in no respect from that seen in civil life. The disease, as a rule, ran a comparatively mild course, and the mortality rate has been distinctly lower than that of the average city hospital. The streptococcus pneumonias, on the contrary, have presented an unusual clinical picture, have run a severe course, and the mortality rate has been high.

The autumn of 1917 proved to be a most healthy season at Camp Upton. Up to December 1st scarcely more than a dozen pneumonias were admitted to the Base Hospital. Without ex-

ception these were pneumococcus infections of the lobar type and ran a very mild course. On Christmas Day, 1917, the first case of streptococcus pneumonia was admitted to the Base Hospital. This patient had just arrived from Fort Slocum, and gave a history of being taken ill just before leaving that post. The hemolytic streptococcus was found in his sputum. Two other hemolytic streptococcus cases were admitted shortly after, both colored men. One had been transferred from Camp Lee and the other from Camp Pike. These cases marked the beginning of streptococcus pneumonia at Camp Upton, and it became more and more prevalent as the winter advanced, so that by spring the majority of pneumonias admitted to the Base Hospital were of streptococcic origin. The negro troops were particularly susceptible to streptococcus pneumonia. While they constituted only about 10 per cent. of the average strength of the camp, they contributed more than 50 per cent. of the streptococcus pneumonias.

A number of other cases of streptococcus pneumonia occurred among the negro troops who were transferred from Camp Pike to Camp Upton, and as streptococcus pneumonia was quite prevalent at Camp Pike during this period, there seems no reason to doubt that these colored troops were instrumental in introducing the hemolytic streptococcus at Camp Upton, and were responsible for the epidemic of streptococcus pneumonia which followed. Furthermore, it may be said that the wide distribution which this virulent organism achieved was almost certainly due to the indiscriminate transportation of troops from infected camps into the various other camps all over the country. It is probable that if these infected negroes could have been kept out of Camp Upton pneumonia would have contributed a comparatively unimportant part in the camp morbidity, and that we would have been able to maintain throughout the year the remarkably low morbidity rate of the autumn months.

However, the hemolytic streptococcus, having been introduced into Camp Upton, gradually spread throughout the various organizations until streptococcus pneumonia assumed rather large proportions during March and April. Up to

February 1st pneumococcus infections had predominated, but from February 1st to the present time the cases of streptococcus pneumonia have outnumbered the pneumococcus cases.

Captain H. F. Vaughan, the Camp Epidemiologist at Upton, has shown quite clearly on charts the importance of weather conditions as a predisposing factor in pneumonia. Captain Vaughan's charts show that there were two distinct periods of increase in the incidence of pneumonia at Camp Upton. The first up-wave consisted of pneumococcus infections, and occurred in December and early January, following the arrival of colored rural troops from the South. These men had been in the service only six weeks and were unaccustomed to the hardships and exposure of military life. It happened that this was a period of thaw, accompanied by heavy rainfall. The men frequently got wet, and this, together with the other conditions, led to the increase in pneumonia. In March there was another thaw, and by this time the hemolytic streptococcus had become well disseminated throughout the camp. This was shown by the throat cultures taken from a considerable number of troops at this time. The March thaw was accompanied by a marked increase in the incidence of pneumonia, mainly of the streptococcus type. There was also an epidemic of influenza and bronchitis in camp at this time.

The pneumonias which have occurred at Camp Upton during the past winter and spring have been studied with particular care, and an effort has been made to secure accurate sputum examinations in every case. During the early part of the season, before the Base Hospital was opened, bacteriologic examinations were not possible, and again, later on in the spring, when sometimes 15 or more pneumonias were admitted to the hospital in one day, a number of the cases escaped sputum examination. With these exceptions, however, practically every case of pneumonia admitted to the hospital received a bacteriologic examination of his sputum. In a large number of cases the sputum examination was made by two or three different methods, and in some instances repeated specimens were examined with the idea of detecting changes in the character of the infection if

such occurred. Special attention was devoted to the collection of the sputum. At the beginning we tried to have this done by the nurses and orderlies, but it was soon found that they were not sufficiently careful to obtain the proper kind of specimen. It was decided, therefore, that every sputum should be collected by some member of the laboratory staff. In the cases where the patient was unable to cough when requested a sterile Petri dish was left by the bedside, with instructions to the patient to expectorate into the Petri dish when he was able. By using this method we were fairly sure that the specimen came from the chest and not from the nasopharynx.

After the sputum had been thoroughly washed smears were made for Gram and capsule stains, and an emulsion of the sputum in salt solution was then prepared in the usual manner.

Three methods of sputum examination have been employed: (1) inoculation of mouse; (2) Avery's blood broth method; (3) direct culture of emulsified sputum on blood-agar plates. In a large number of cases two or more of these methods have been used on the same sputum in order to check up the accuracy of the methods and to give us increased confidence in the bacteriologic findings.

From October 1, 1917, to August 1, 1918, 423 pneumonias were admitted to the Base Hospital at Camp Upton; 382 of these had one or more bacteriologic examinations made on the sputum. In 41 cases the sputum was not examined. The following table shows the number of times each method was used:

1. Mouse alone	98
2. Blood broth alone	158
3. Mouse and blood broth	75
4. Blood broth and direct culture	27
5. Mouse and direct culture	1
6. Mouse, blood broth, and direct culture	15
7. Direct culture alone	8

Of the 382 cases of pneumonia in which bacteriologic examinations were made on the sputum, 161 were of pneumococcus origin and 182 of streptococcus origin (see Table I). In other words, the pneumococcus and streptococcus played an almost equal

part, numerically, in the etiology of pneumonia. There were 6 cases in which the Bacillus influenzæ was the predominating organism, and 6 others in which the Micrococcus catarrhalis was apparently the causative agent. There was 1 case of Staphylococcus aureus pneumonia, and, finally, there were 26 cases of mixed infection in which the pneumococcus and streptococcus were both found.

Table II shows the incidence of the various pneumococcus types. It will be seen from this table that the Type IV pneumococcus was by far the most prevalent of the four types, occurring more frequently than the other three types combined. One reason for this was undoubtedly the extensive use of pneumococcus vaccine against the first three types. This subject will be referred to later. Type IV pneumococcus was, however, the most common type even before the vaccine was instituted, and the same predominance of Type IV has been observed in a number of other camps. At one time it was feared that there was some fault in our method of typing sputa, but when we found Type IV pneumococcus in the pleural fluid of 6 cases of Type IV that developed empyema, and when, furthermore, Type IV pneumococcus was recovered in a number of instances from the lungs at autopsy, we were forced to conclude that our examinations were, for the most part, accurate.

Clinically, the Type IV cases ran a mild course, showing a mortality rate of only 16.3 per cent. The Type I pneumonias gave a mortality of 13.8 per cent., and if those cases that did not receive serum be excluded, the mortality in this group was only 10 per cent.. The Type II pneumonias showed the highest mortality, 33.3 per cent., while the Type III cases, with a mortality rate of 23.1 per cent., ran a considerably milder course than those seen in civil life. The pure pneumococcus infections were almost without exception primary. Only 13 cases followed measles, and there were a few cases which came on after an attack of influenza. Most of these cases presented the classic picture of lobar pneumonia, *i. e.*, the type of pneumonia usually seen in civil practice. There were a few cases of central pneumonia, and in some of the mixed infections patches of broncho-

pneumonia could be demonstrated by *x*-ray or autopsy in addition to the lobar consolidation.

Complications were comparatively rare in the pneumococcus infections. Empyema was the commonest complication and occurred 27 times in this series. In 16 of these the pneumococcus was recovered from the pleural exudate, and in 11 the streptococcus was found. In 10 cases other cloudy or seropurulent fluid was removed from the chest, the cultures from which were sterile.

Pneumococcus empyema usually develops late in the course of the pneumonia when the patient is convalescent. There is a sudden rise in temperature and a corresponding increase in pulse-rate. Frank signs of fluid are usually present, and upon exploring the chest over these areas cloudy or purulent fluid is withdrawn, which on examination shows many pus-cells and capsulated pneumococci.

Pneumococci of Types I, II, and IV are all represented in this group of empyemas, and in all except one case the same type of pneumococcus was found in both sputum and pleural exudate. Of this group of 27 empyemas, 12 died, a mortality rate of 44.4 per cent.

A majority of the pneumonias which have occurred at Camp Upton during the past ten months have been of streptococcus origin, and these cases have excited more interest than the pneumococcus cases: (1) because of their comparative rarity in civil life; (2) their unusual bacteriologic picture; (3) the frequency of empyema as a complication; (4) their higher mortality rate.

These cases also differ from pneumococcus cases in that they are frequently secondary to some other infection—23 of the streptococcus cases followed measles; 5, mumps; 1, German measles; 3, scarlet fever; 12, influenza, or some other infection of the upper respiratory tract. In other words, less than 75 per cent. of the streptococcus pneumonias were primary infections, and it is probable that if more careful histories could have been obtained a still larger percentage of these cases would have proved to be secondary infections.

At the outset it is necessary to divide the streptococcus pneumonias into two groups: (1) the hemolytic streptococcus pneumonias, (2) the non-hemolytic streptococcus pneumonias (see Table III).

One hundred and eighteen pneumonias in this group, or 64.8 per cent., were due to *hemolytic* streptococcus. This is the type of pneumonia which has been so frequent in the various cantonments during the past winter, and which has been described by a number of writers.[1] These cases present a fairly definite and characteristic clinical picture. The patient who often gives a history of some recent infection of the upper respiratory tract is admitted to the hospital complaining of cough, fever, and frequently pain in the side. The onset, as a rule, is gradual, though it may be very sudden. Many cases are admitted with a diagnosis of influenza or bronchitis. The cough, in the beginning, is dry in character and often absent, a feature which makes it difficult or impossible to collect a satisfactory specimen of sputum. The sputum itself is rather characteristic. It is usually a white or yellowish color, quite viscid and mucopurulent. The typical rusty or hemorrhagic sputum of lobar pneumonia is uncommon. In 118 hemolytic streptococcus cases, 89 showed mucopurulent sputums and 29 showed rusty sputums. Pain in the side is a fairly constant symptom and was present in 62 per cent. of the cases.

The physical signs in this type of pneumonia are often indefinite. One of the most characteristic features is the marked prostration which is usually present. The patient appears markedly exhausted. Cyanosis is usually noted, but there is not the marked dyspnea and expiratory grunt so often seen in lobar pneumonia. Profuse sweats very frequently occur, while chills are comparatively rare. Areas of dulness can often be made out, but are usually circumscribed. Moist, crackling

[1] Alexander, H. A.: Jour. Amer. Med. Assoc., 1918, lxx, 775–776. Cecil, R. L., Austin, J. H.: Jour. of Exper. Med., 1918, xxviii, 1–9. Cole, R., MacCallum, W. G.: Jour. Amer. Med. Assoc., 1918, lxx, 1147–1156. Cummings, J. C., Spruit, C. B., Lynch, C.: Jour. Amer. Med. Assoc., 1918, lxx, 1066–1070. Fox H., Hamburger, W. W.: Jour. Amer. Med. Assoc., lxx, 1758–1760. Lucke, B.: Jour. Amer. Med. Assoc., 1918, lxx, 2006–2011.

râles are nearly always heard, but typical bronchial breathing and voice are rather unusual signs at the onset of the disease. Quite often the voice and breath sounds are faint.

Diagnosis.—This can usually be made without much difficulty by anyone familiar with this type of pneumonia, but under all circumstances the *x*-ray is of great value in confirming the diagnosis. *x*-Ray examinations in these cases show many small patches of consolidation scattered usually throughout both lungs, sometimes only one. It is quite common in *x*-ray plates to find large patches formed by the coalescence of a number of small patches, and sometimes this union produces a picture which simulates lobar consolidation.

Hemolytic streptococcus infections almost invariably run a severe course, chiefly on account of the high frequency of complications. The temperature is of a septic type—irregular—like that seen in streptococcus septicemia. Strange to say, however, the blood-culture is usually sterile. Blood-cultures taken in 47 cases gave 10 positive results. Of these, 6 proved to be fatal. The pulse tends to become more rapid as the disease progresses. These patients waste rapidly, and a high calory diet has recently been recommended to combat this symptom.

In 53 uncomplicated cases the mortality rate was 11.3 per cent.

Complications of one kind or another occurred in 65 of the hemolytic streptococcus cases. By far the commonest of these was empyema, which was demonstrated in 41 out of 118 straight hemolytic streptococcus pneumonias. In a series of mixed infections there were 10 hemolytic streptococcus empyemas, and the hemolytic streptococcus was found in 8 cases in which, for some reason, the sputum was not examined. It is fairly safe to assume that all of these were cases of hemolytic streptococcus pneumonia. Summarizing, then, we may say that out of 118 hemolytic streptococcus cases, empyema was demonstrated in 50 per cent.

This complication has been responsible in a great measure for the high mortality which has accompanied this type of pneumonia. Indeed, streptococcus empyema has become such a problem in the American cantonments that a special board has been

appointed by the Surgeon General to study the disease and to determine, if possible, the most successful type of treatment.

One of the most striking features of streptococcus empyema is its early appearance. In many cases the patient is discovered with a chest full of cloudy fluid at the time of admission to the hospital. In the series of cases of empyema studied by Brooks and Cecil a positive diagnosis of empyema was made on an average of 5.4 days after admission to the hospital. The early appearance of empyema may completely mask the underlying bronchopneumonia, and the claim has been made by good observers that streptococcus empyema can develop without any preceding pneumonia.

The diagnosis of this complication is often difficult because of the vague and indefinite physical signs. With the formation of pus there is usually a perceptible increase in the respiratory rate, but the temperature and pulse curve show no change. The classic signs of empyema may be entirely absent. Breath and voice sounds and tactile fremitus may be transmitted through massive exudates with great distinctness. The physical sign which is perhaps the most valuable in the detection of these effusions is alteration of the percussion note. Skin tenderness is observed quite frequently over the affected side and has come to be looked on as quite characteristic. Skodaic resonance has been noted in many cases and is a valuable sign when present.

The *x*-ray is of great value in the diagnosis of empyema and should be employed as a routine measure in all cases of hemolytic streptococcus pneumonia. If fluid is present in any considerable degree, it will be demonstrated, almost without exception, by a good roentgenologist. In all cases of doubt the hypodermic needle should be resorted to, and should be used freely. The pain caused by this diagnostic method is so slight that the patients do not object to frequent taps.

Character of Empyema Fluid.—The pleural exudate, when removed, is usually light yellow, often with a greenish tinge, and in the early stages is only slightly cloudy. Later in the disease it may take on a distinctly purulent character. Smears from the fluid show pus-cells in large numbers, and large round

or slightly flattened cocci arranged in short chains of two to ten organisms. We have observed that the bacteria are much more numerous in streptococcus empyema than in pneumococcus empyema. Cultures from the exudate on blood-agar show after twenty-four hours' incubation many small, moist, elevated opaque colonies of a pearl gray color, each surrounded by a wide and sharply defined zone of hemolysis. Subcultures in blood broth produce clouding of the media with a heavy sediment in the bottom of the tube. Rapid destruction of the blood-cells takes place and the blood broth takes on a brilliant claret red color. Smears from the blood broth show chains of cocci similar in all respects to those seen in the smears from the pleural exudate.

The mortality rate of this type of empyema was very high not only in this camp, but in other camps where the complication was prevalent. Of the 55 cases in our series, 31 died, a mortality rate of 56.4 per cent.

Other complications: Next to empyema, the most common complication in this type of pneumonia is pericarditis. Fibrinopurulent pericarditis has occurred in 6 of our hemolytic streptococcus cases, in all but one case being associated with empyema. This is a very serious complication and develops usually by direct extension of the pleural infection into the pericardial sac. Other complications which have been noted in the hemolytic streptococcus pneumonias are: acute general peritonitis, 1; abscesses in lung, 3; parenchymatous nephritis, 2; otitis media, 5; meningitis, 2; peritonsillar abscesses, 4; septicemia, 1; acute fibrinous pleurisy, 3; cardiac dilatation, 1.

Non-hemolytic Streptococcus Pneumonia.—There were 64 cases of non-hemolytic streptococcus pneumonia, 35.2 per cent. of the total series. This type of pneumonia is very similar pathologically and clinically to the hemolytic streptococcus variety, but runs a much milder course. Complications are not so frequently encountered. A diagnosis of the non-hemolytic streptococcus pneumonia was always made by the method of exclusion, *i. e.*, after the pneumococcus, hemolytic streptococcus, or other virulent organisms had been excluded. The constant

presence of this organism in the normal saliva causes it to be a very frequent contamination in sputum examinations, and it was not accepted as an etiologic factor except in those cases where a satisfactory sputum was obtained. In a number of these cases the bacteriologic diagnosis was substantiated by obtaining the same organism from a complicating empyema, or from the lung at autopsy. Non-hemolytic streptococcus pneumonias have not been reported as prevalent in any of the cantonments except Camps Wheeler and Shelby. Zingher has recently described an epidemic of non-hemolytic streptococcus empyemas which occurred at Camp Shelby. The organism he described agrees in every way with the type which we usually found in our cases at Camp Upton.

These cases usually ran a mild and short course unless complications set in. The mortality rate in the uncomplicated cases was only 4.3 per cent., which is much less than for any other type of pneumonia. Even when the cases with complications are included the mortality rate is only 9.3 per cent. In some of the cases the disease ran such a mild course that the diagnosis could not have been made without the confirmation of the *x*-ray.

Complications.—The most common complication in this group, as in the hemolytic streptococcus group, was empyema—7 out of 64 cases developed empyema, an incidence of 10.9 per cent. The mortality rate for the empyemas of this group was 57.1 per cent. Other complications were rare. Pericarditis occurred 4 times; meningitis, 1; otitis media, 3; chronic glomerular nephritis, 1; acute fibrinous pleurisy, 1.

Pathogenesis.—The question of ward infection in pneumonia—that is, whether patients suffering from pneumonia of whatever type are likely to contract a streptococcus infection from their associates in the ward or from streptococcus carriers—receives some confirmatory evidence from the fact that our groups of cases include 11 incidences in which a pneumococcus infection of the lungs was associated with a streptococcus empyema. The likelihood of an autogenous infection from streptococci already in the mucous tract of patients when they contract pneumonia seems probable in some cases. This theory

has received some support at Camp Upton from a series of cultures made during an epidemic of streptococcus pharyngitis in the course of which a number of streptococcus pneumonias developed. Cases of pneumonia followed by empyema and all apparently inaugurated by a preliminary pharyngitis are found on our lists.

Pathology.—Of our streptococcus pneumonias, 29 came to autopsy—23 of these were hemolytic streptococcus cases and 7 were non-hemolytic cases. Pathologically the two groups are indistinguishable. Of the 29 cases that came to autopsy, 18 cases were frank bronchopneumonias and 11 were of the lobar type. Of the latter group 3 were mixed infections, and the presence of a pneumococcus probably accounts for the lobar pneumonia.

The pathology of streptococcus pneumonia has been recently described by MacCallum and others. Streptococcus pneumonia is essentially a bronchopneumonia, in that the lesions are nearly always limited to the neighborhood of the bronchioles. In some severe cases the infection may be so extensive that the process in the gross resembles a lobar pneumonia, but microscopic examination will show that even in these cases the consolidation is patchy, not massive, as it is in lobar pneumonia. MacCallum has described peculiar and rather characteristic changes in hemolytic streptococcus pneumonia. He speaks of this type of pneumonia as an "interstitial" pneumonia because the changes are chiefly in the interstitial tissue rather than in the alveoli. At autopsy the lungs appear nearly always atelectatic as a result of the empyema usually found in fatal cases. This compression is even more marked if thoracotomy has been performed and a pneumothorax established. The surface of the lung is covered with a thick yellowish membrane of fibrin which is peeled off with difficulty. On section the cut surface is congested and edematous. The bronchioles stand out with remarkable distinctness and are usually filled with pus. The walls of the bronchi appear thicker than normal and there is an overgrowth of fibrous tissue throughout the organ which accentuates the fibrous trabeculæ. Thickening about the bron-

chioles may be so marked as to give them the appearance of small tubercles. In fact, the diagnosis of miliary tuberculosis was made in a number of earlier cases. Combined with these changes one may find the typical small grayish elevated patches of bronchopneumonia, and these latter may be so extensive that the picture simulates in a rough way that of lobar pneumonia. Microscopic sections of the lungs in these cases show an extensive infiltration of lymphoid cells about the bronchioles and blood-vessels. The epithelial lining of the bronchiole in many cases has been destroyed and replaced by granulation tissue. This inflammatory reaction shows itself throughout the entire wall of the bronchiole, and the young vascular granulation tissue which has replaced the alveoli immediately adjacent to the bronchiole accounts for the small tubercle-like bodies which are seen in the gross examination of the lung. In some places the process has been limited to the bronchioles, so that the process could be well designated as "acute bronchiolitis." In other places, however, the alveoli in the neighborhood of the bronchiole are filled with an exudate of polymorphonuclear leukocytes and lymphoid cells suspended in a network of dense fibrin. This exudate shows a marked tendency to organize, and in some instances the complication of atelectasis and organization of the exudate so completely transforms the normal architecture of the lung that one could almost be excused for not recognizing it as pulmonary tissue. Another characteristic of the infection is the formation of small biliary abscesses. The bronchioles already filled with pus lose their mucous membrane and the overgrowth of granulation tissue occludes the lumen, with the production of circumscribed foci of infection. These small miliary abscesses may occur in large numbers and offer one of the most plausible explanations for the frequency of empyema as a complication.

When suppurative pericarditis develops in these cases it is almost always associated with empyema, and the character of the fluid and the general appearance of the fibrous exudate on the pericardium are almost identical with the fluid and exudate in the pleura. They are, in fact, one and the same process.

Changes similar to those described by MacCallum have been noted by Lucke at Camp Taylor.

The **treatment** of pneumonia at Camp Upton can be described very briefly. The lobar pneumonias were treated just as they would be in civil practice. Where circumstances will permit the patients are placed in the open air. As a rule, digitalis is given freely in the early stages, and camphor, adrenalin, and caffein are administered as symptoms indicate. The usual attention is given to elimination and the temperature is controlled, at least in part, by hydrotherapy. Where the pain is severe or where the cough is troublesome, codein or morphin is used in moderate doses. In 20 cases of Type I pneumonia Type I antipneumococcus serum was employed, with excellent results. The technic recommended by Avery, Chickering, Cole, and Dochez has been faithfully followed. As soon as the diagnosis of pneumonia was made the patient immediately received $\frac{1}{2}$ c.c. of normal horse-serum subcutaneously. If the case proved to be a Type I infection, the patient at once received antipneumococcus serum intravenously, usually 90 to 100 c.c. The first 10 c.c. were allowed to run in very slowly in order to guard against any symptoms of anaphylaxis. The injection of the serum was followed almost immediately by a sharp rise in temperature amounting to 1 or 2 degrees. This was followed by a sharp drop of several degrees, which was sometimes very striking. The temperature usually rose again, but by repeating the intravenous injection of serum every twelve hours the temperature was usually brought down permanently by the second or third day after the initiation of treatment.

Thirty-five cases of pneumococcus Types II, III, and IV pneumonia were treated with a polyvalent antipneumococcus serum which had been sent to us in the early fall by the government for trial. This serum produced a drop in temperature very similar to that observed with Type I serum, and in some instances it seemed to exert a beneficial effect on the patient. The mortality rate, however, in this series of cases (37 per cent.) does not indicate that the serum possessed any curative value. It has, therefore, been discontinued.

Two cases of anaphylaxis occurred among our serum-treated cases. The first case was that of a young negro who had pneumococcus Type III pneumonia following measles. A desensitizing dose of 1 c.c. of normal horse-serum was given, and this was followed two hours later by 100 c.c. of polyvalent antipneumococcus serum intravenously. Five minutes after the injection acute anaphylactic symptoms developed—intense dyspnea, restlessness, weakened pulse, and relaxation of the sphincters. The symptoms gradually passed away after fifteen minutes and the patient made an uneventful recovery.

The second case was that of a young man with pneumococcus Type III infection, but of a much more severe character than that just described. An injection of 100 c.c. of polyvalent antipneumococcus serum produced a temporary drop in temperature. No other serum was administered until seventeen days had passed, when the patient had a relapse and the ward surgeon requested another injection of serum. The desensitizing dose was given at noon, and the injection of the antipneumococcus serum was started at 3.00 P. M. When 50 c.c. of serum had been administered the patient suddenly exclaimed that he could not breathe, and became very cyanotic. In spite of artificial respiration and stimulation the patient died in a few minutes.

Prophylaxis Against Lobar Pneumonia.—Pneumonia is coming to be looked upon more and more as a contagious disease. If it is such, every patient suffering from this disease should be isolated as soon as possible and his contact with other individuals reduced to a minimum. Steps should also be taken to protect the community against pneumonia carriers. These individuals are a constant source of danger. The control of healthy carriers, however, is one of the most difficult problems which a sanitary officer has to contend with, and one which has not yet been satisfactorily solved.

The success of prophylactic vaccination against typhoid fever naturally suggests an effort to combat pneumonia with the same method. Animal experiments have shown that it is easy to produce active immunity by an injection of small doses of dead pneumococci. This immunity lasts for a considerable

time and the good results obtained by Lister in vaccinating miners against pneumonia in South Africa moved us to undertake vaccination against pneumonia at Camp Upton. In some preliminary experiments on volunteers at the Base Hospital it was shown by study of the agglutinations and protective power of the serum in 42 persons vaccinated against pneumococcus Types I, II, and III that a definite immune response could be secured against Types I and II by moderate sized doses of vaccine administered subcutaneously. Little evidence of an immune response to Type III could be determined by this method, but too much significance should not be attached to this, as it is relatively difficult to obtain antibodies in the serum against this strain, even though a considerable degree of active immunity may have been produced in the vaccinated animal.

At Camp Upton 12,519 men were vaccinated against Types I, II, III. Three or four doses were given at intervals of five to seven days, with the total dosage of 6,000,000,000 to 9,000,000,000 for Types I and II, and 4,500,000,000 to 6,000,000,000 for Type III. The local reaction varied greatly in different individuals. The vaccinated men were under observation for ten weeks after vaccination. During this time no case of pneumonia of the three types occurred among the men who had received two or more injections of the vaccine. In a control of approximately 20,000 men there were 26 cases of pneumococcus Types I, II, and III during the same period. The incidence of pneumococcus Type IV penumonia was much lower among the vaccinated troops than among the unvaccinated. As a result of these investigations it is apparent that vaccinations against pneumonia gave satisfactory protection against the types which composed the vaccine.

The duration of the immunity has not yet been determined, but protection is probably obtained for six to twelve months. Pneumonia vaccine will be used extensively in the American army during the coming winter.

Treatment of Streptococcus Pneumonias.—The treatment of streptococcus pneumonia is expectant and differs in no essential way from that of the pneumococcus cases. As yet no serum has

been devised for the treatment of these cases. The prophylactic treatment in this connection consists in protecting patients with measles and other infections from hemolytic streptococcus carriers. This is particularly true in the case of measles. Every patient with measles should have a throat culture immediately on his arrival in the hospital, and all those cases in which hemolytic streptococci are present should be placed in a separate ward. The plan of separating pneumonia patients by means of cubicles has a good rational basis, and undoubtedly prevents many mixed infections.

Treatment of Empyema.—This is the most important problem in connection with streptococcus pneumonia, for the high mortality in this type of pneumonia has undoubtedly been due to the frequency of a complicating empyema.

In ordinary empyema of pneumococcus type an early operation is indicated. In the usual run of cases operation is followed by prompt improvement and eventful recovery of the patient.

The streptococcus empyema problem is quite different. A review of cases of empyema operated on in the Base Hospital at Camp Upton, N. Y., shows that those cases operated on early have almost always died, while those in which the operation had been postponed until the pus had become thicker and well walled off, usually recovered. In the latter group, of course, frequent aspirations were done to relieve pressure in the chest. It seems reasonable to suppose that when the pleural cavity is drained during active bronchopneumonia the rapid collapse of the diseased lung on the side operated upon throws an added strain on the already weakened heart, and for this reason is often instrumental in hastening the patient's death. By postponing operation, however, until the pneumonia has begun to resolve the heart has a chance to adjust itself to the extra strain; there is less toxemia, and the lungs are in better condition when the operation is finally performed. When the patient does come to operation the drainage of the empyema cavity should be complete and continuous, and Dakin's solution should be used in cleansing and disinfecting the cavity. An excellent review of the treatment of empyema is found in a recent number of the

Journal of the American Medical Association by the Empyema Commission situated at Camp Lee, Virginia. This report goes into the treatment of empyema at great length and gives full instructions as to how Dakin's solution should be employed in the disinfection of an empyema cavity. This phase of the question, after all, is a surgical problem, and I will, therefore, leave it to my surgical colleagues for proper solution.

TABLE I

CLASSIFICATION OF PNEUMONIAS

	Incidence.	Percentage.	Mortality.	Percentage.
Pneumococcus	161	42.1	29	18.0
Steptococcus	182	47.6	47	25.8
Bacillus influenzæ	6		0	
Micrococcus catarrhalis	6		0	
Straphylococcus aureus	1		0	
Mixed infections (pneumococcus and streptococcus)	26	6.8	7	26.9
	382		83	21.7

TABLE II

INCIDENCE OF PNEUMOCOCCUS TYPES

	Incidence.	Percentage.	Mortality.	Percentage.
Pneumococcus Type I	29	18.0	4	13.8
Pneumococcus Type II	15	9.3	5	33.3
Pneumococcus Type III	13	8.1	3	23.1
Pneumococcus Type IV	104	64.6	17	16.3
	161		29	

TABLE III

INCIDENCE OF STREPTOCOCCUS TYPES

	Incidence.	Percentage.	Mortality.	Percentage.
Hemolytic streptococcus	118	64.8	41	34.7
Non-hemolytic streptococcus	64	35.2	6	9.3
	182		47	

TABLE IV

PNEUMONIA AND EMPYEMA

Pneumococcus in sputum and pleural fluid:	Cases.	Deaths.	Mortality per cent.
Pneumococcus Type I	4	0	
Pneumococcus Type II	4	2	50
Pneumococcus Type III	0	0	
Pneumococcus Type IV	6	3	50
	14	5	35.7

Streptococcus in sputum and pleural fluid:	Cases.	Deaths.	Mortality per cent.
Hemolytic streptococcus	37	21	56.8
Non-hemolytic streptococcus	4	3	
	41	24	58.5
Sterile empyemas:			
Pneumococcus Type I in sputum	1	1	
Pneumococcus Type II in sputum	2	2	
Pneumococcus Type III in sputum	1	1	
Pneumococcus Type IV in sputum	5	2	
Hemolytic streptococcus in sputum	3	2	
Non-hemolytic streptoccccus in sputum	3	1	
(Sputum not typed)	1	1	
	16	10	66.6
Sputums not typed:			
Hemolytic streptococcus in pleural fluid	8	7	
Pneumococcus Type IV in pleural fluid	1	1	
Staphylococcus aureus in pleural fluid	11	0	
	20	8	80
Mixed infections:			
Pneumococcus Type II in sputum; Hemolytic streptococcus in pleural fluid	2	1	
Pneumococcus Type III in sputum; Hemolytic streptococcus in pleural fluid	1	0	
Pneumococcus Type IV in sputum; Hemolytic streptococcus in pleural fluid	5	2	
Pneumococcus Type II in sputum; Non-hemolytic streptococcus in pleural fluid	1	1	
Pneumococcus Type IV in sputum; Non-hemolytic streptococcus in pleural fluid	2	2	
Pneumococcus Type IV in sputum; Staphylococcus aureus in pleural fluid	1	1	
Pneumococcus Type II in sputum; Pneumococcus Type II and IV in pleural fluid	1	0	
Pneumococcus Type IV and non-hemolytic streptococcus in sputum; Staphylococcus albus in pleural fluid	1	1	
Pneumococcus Type IV and non-hemolytic streptococcus in sputum; Sterile pleural fluid	1	0	
Pneumococcus Type IV and hemolytic streptococcus in sputum; Sterile pleural fluid	1	0	
Pneumococcus Type IV and hemolytic streptococcus in sputum; Hemolytic streptococcus in pleural fluid	1	0	
	17	8	

TABLE IV—*Continued*

Mixed infections:	Cases.	Deaths.	Mortality per cent.
Hemolytic streptococcus in sputum; Pneumococcus Type IV in pleural fluid	1	0	
Non-hemolytic streptococcus in sputum; Hemolytic streptococcus in pleural fluid	1	0	
	2		42.1

Total number of empyemas	99
Total number of deaths	55
Mortality, per cent	55.5

ANTHRAX

By Major Charles L. Mix, M. C., U. S. A.

Medical Director of Base Hospital, Camp Mills, Long Island

On the 11th day of June, 1918, we received our first case of anthrax at the Base Hospital at Camp Mills. The patient, W. O. B. (No. 2184), a native of Arizona, had recently arrived from the Southwest. He had had no tropical service or diseases and his family history was immaterial. The thing that disturbed him was a left cervical cellulitis. The entrance diagnosis was "cellulitis, left cervical region, anterior. Severe. Cause unknown." We learned that on the 9th day of June he noticed a pimple on the left side of his neck, well forward. This gradually enlarged and led to a marked cellulitis with subjective soreness of the left side of the neck. On entrance he was sent to a surgical ward where an operation was done on the same day, the neck being merely incised and drained. Culture made at the time showed numerous staphylococci present. Owing to the fact that the condition of the patient was far more serious than would be warranted by staphylococcus infection, subsequent bacteriologic examination was made on the following day, and on June 14th, forty-eight hours after entrance, a culture from the wound showed anthrax bacilli. Immediately 100 c.c. of antianthrax serum were given intravenously and an additional 100 c.c. later in the day. On June 15th the pulse was rapid and weak, the respiration shallow, and his condition was bad; 350 c.c. of antianthrax serum were given intravenously during that day. In addition, the wound was covered daily with wet boric acid dressings saturated every two hours, and an ice-bag applied to his head. The temperature was always high, ranging from 103.2° to 104.6° F. He slept very little.

At the time of the operation curetings from the neck were sent to the laboratory for examination, and no micro-organisms were then said to be demonstrable. It was not until the afternoon of June 14th that a culture from the deep structures of the neck showed staphylococci and a spore-bearing bacillus resembling anthrax morphologically.

Antianthrax serum was given as follows:

June 14th, 3.15 P. M., 100 c.c.; 8.00 P. M., 100 c.c.

June 15th, 11.30 A. M., 50 c.c.; 4.15 P. M., 100 c.c.; 7.30 P. M., 200 c.c.

At 9.30 P. M. he had a chill, resulting from the last serum injection, which lasted fifty minutes. He was given no more serum after the last injection at 7.30 P. M. on June 15th, his condition being so bad that a fatal ending seemed inevitable. He died at 1.10 P. M. on June 16th.

We frankly confess that this first case of anthrax was neither promptly recognized nor effectively treated. It is the only one of the entire 6 cases which we have had which ended fatally. The faults in the treatment of this case were late diagnosis, made two days after entering the hospital and five days after being taken ill, and improper and imperfect treatment. In our opinion at the present time it is unnecessary to make deep drainage incisions into the associated cervical cellulitis, the main essential being merely to excise the malignant pustule itself. Furthermore, prompt recognition of the true nature of the condition is a *sine qua non* for recovery. Unless the condition is promptly recognized, inevitably the disease spreads through the body, bacillemia results, and the patient dies.

The remaining cases of anthrax may be briefly summarized as follows:

CASE II.—C. U. This patient entered the hospital June 12th, the day following the entrance of Case I on June 11th; he left August 23d. The admission diagnosis was "undetermined." The patient stated that on June 8th he noticed a small pimple on the right side of his cheek; that he then went to the regimental surgeon, who opened it, but that after this slight operation his face became swollen and tender, the swelling extending down

the neck and into the submaxillary region. On entrance into the medical service of the hospital the patient presented a distinct malignant pustule on the right cheek with marked swelling extending from the ear down the neck. He felt sick and had severe headache. The cervical glands could not be picked out individually, there being merely a very large mass. He was at once taken to the laboratory from the receiving ward, the pustule was opened, and a slight amount of pus and serous fluid exuded. A smear showed the presence of staphylococcus. In view of the patient's very serious condition I would not accept this report and demanded another search. On the next day, June 13th, the anthrax bacilli were found. Though this patient entered twenty-four hours later than Case I, the anthrax bacilli were found on June 13th, twenty-four hours earlier than in the case of W. O. B. Antianthrax serum was given to him at once intravenously in a dose of 50 c.c. At 11.00 P. M. an additional 50 c.c. were given. From this time on administration of the serum was as follows:

June 14th, 4.30 A. M., 50 c.c.; 9.00 A. M., 50 c.c.; 2.30 P. M., 100 c.c.

June 15th, 11.00 A. M., 50 c.c.; 4.00 P. M., 100 c.c.

June 16th, 10.30 A. M., 100 c.c.

June 17th, 10.00 A. M., 50 c.c.

June 19th, 10.00 A. M., 40 c.c.

This patient was at first treated entirely in the medical service without surgical intervention, the only thing done with a knife was the opening of the pustule and the making of a smear from the pus it contained. The lesion on the face was, of course, dressed daily with wet boric acid dressings and the usual aseptic precautions were taken. His temperature at entrance was 102.4° F.; on June 13th, 101° to 103.2° F.; June 14th, from 101° to 102° F.; on the 15th it ranged from 99° F. at noon to 101° F. at 8 P. M. The last high temperature recorded was on this date at midnight, when it was 100.4° F. On the morning of the 16th temperature was normal and remained so from that time on.

The course of this patient's recovery is rather interesting.

He was extremely uncomfortable on the morning of June 12th, when he entered the hospital, at which time the pustule was opened. On the following morning he complained of headache and pain in the neck and back. On June 14th he had the same complaints, but the cellulitis was greater. On June 15th he seemed to be quite ill and complained very much of headache and aching bones, though the fever showed a tendency to a lower range. June 16th the patient appeared much improved; his temperature was down, the pulse good, and the swelling behind the ear and about the neck was subsiding. June 17th and 18th his condition steadily grew better, so that by the 19th the amount of swelling of the neck was considerably lessened. The wound at the site of the pustule showed signs of clearing up, and on the 20th was evidently fading away. By the 21st it was possible for him to sit up in a chair.

The only difficulty which marred his convalescence was an urticarial rash extending over the whole body. Though serum was given to him as early as June 13th, the urticaria did not appear until June 23d. This gradually subsided, being helped possibly by adrenalin, which was given for that purpose in doses of $\frac{3}{200}$ grain hypodermically. By June 30th the pustule was so far healed that the scab upon it came off and left practically no scar, although on July 2d the right submaxillary gland was still tender and somewhat swollen. From this time on, however, this gland began to show signs of breaking down, the swelling increased, the mass being somewhat hard and indurated, so that on July 6th it was judged advisable to give the patient a little ether and open up the infected area. This was the only surgical operation done upon this patient. After operation the condition rapidly cleared up, so that by July 13th drainage had practically ceased, and by July 20th he had entirely recovered. The patient, however, was somewhat of a neurasthenic and complained of inability to do full work, and we kept him for a longer convalescence than was perhaps necessary, namely, until August 23d, at which time he was discharged.

The management of this patient's case was better than the management of the previous one, but it was not the best manage-

ment at that. He was admitted to the medical, not to the surgical, ward, where opportunity for more extensive study was possible. The result was a diagnosis made within twenty-four hours' time after he entered the hospital, prompt administration of antianthrax serum, and quick control of the disease. It was quite interesting to observe how he responded to the serum. It will be noticed that clinically he behaved very much as a case of diphtheria behaves after the antitoxin has been administered. The temperature fell quite rapidly and even the toxemia quickly disappeared, so that the patient very rapidly improved.

The similarity between the effects produced by diphtheria antitoxin and antianthrax serum was shown in another way. Just as the membrane, edema, and swelling fade as if by magic from the throat of the diphtheritic patient, so also under the beneficent influence of the anthrax serum the local malignant pustule healed spontaneously, a scab appeared upon it, and later fell off, leaving no appreciable scar and no deformity such as follows the usual excision operation. I am almost of the opinion, though the number of cases is too small to base an opinion upon, that anthrax cases may ultimately be treated in the same way that diphtheria cases are. Whereas in former years much attention was paid to the local treatment of the throat in diphtheria, in later years such treatment has been largely disregarded because of the far-reaching effects obtained by the use of diphtheria antitoxin. It may also be true in the future that cases of anthrax will be treated largely by the antianthrax serum, the immediate malignant pustule and other local conditions being left to take care of themselves. Nevertheless, in view of the lesson from the four remaining cases, possibly the best method of dealing with anthrax is to excise the pustule, making no incision for drainage in the area showing cellulitis, and to treat the case with antianthrax serum. This combination treatment, surgically by excision of the sore and medically by the administration of antianthrax serum, will probably be found to be the best method of procedure.

Case III.—C. D. This patient entered the hospital June 18,

1918, from Florida, with a diagnosis of "anthrax"(?). He stated that on June 16th he noticed a small pimple over his right cheek. He picked this and expelled a small amount of fluid from it, but no pus. On the following day the sore became large, swelling appeared, and extended down the right side of the face and neck. He complained of severe headache and fever and stiffness in the back of the neck. The pustule was an exceedingly malignant appearing sore on the right cheek, about ½ inch in diameter. About the sore there was a good deal of marked induration extending from the cheek down the right side of the neck. The patient appeared very ill and feverish, and showed marked constitutional symptoms. He was at once taken to the laboratory and the diagnosis made then and there, but in this instance we followed a new line of procedure. The pustule was excised and the anterior and posterior triangles in the right side of the neck were opened wide. This was done as promptly as possible. For example, the patient entered at 11.00 A. M., and the administration of the anesthetic was begun at 2.00 P. M.

Some interesting observations were made in regard to the bacteriology in this case. The pustule itself showed anthrax bacilli, and they were found in the tissue for a distance of about 1 inch. No anthrax bacilli were found in the incisions made in the anterior and posterior triangles of the right side of the neck.

A new line of procedure was also adopted in giving the antianthrax serum. He was given 150 c.c. intravenously and an additional 50 c.c. were injected into the wound on the face about the place from which the sore had been excised. Next day the patient was very ill and 200 c.c. of antianthrax serum were given intravenously. The wound looked clean and wide open. Fever was high, ranging from 104° F. at noon, which was the temperature he had the previous day at entrance, to 101° F. that night at 11.00 P. M. On June 20th the patient's pulse fell to its lowest, namely, 80, though the quality was good, from a maximum of 110 the preceding day. He appeared very ill and was extremely restless; 200 c.c. of antianthrax serum were given intravenously and quite a reaction followed, the temperature rising to 105° F. at 4.00 P. M.; his pulse, however, was only

88, showing that the temperature was probably due to a marked serum reaction. At 11.00 P. M. temperature was 102.8° F. and the pulse 80. Examination of the region of the excised pustule showed the wound to be clean. The swelling behind the right ear and along the neck had also subsided.

June 21st 200 c.c. of antianthrax serum were administered intravenously. Temperature was distinctly lower on this date, the maximum being 101.6° F., the general condition showed some improvement, and the pulse was of good quality. On June 22d he reached normal temperature for the first time at 4.00 P. M., and from then on had no more fever. He complained merely of soreness in the neck on that day. The wound appeared in excellent condition, and in the evening he confessed to feeling quite well. On June 23d he was much improved, his general condition was good, and the swelling had disappeared. From this time on the patient gradually grew better until the time of discharge, when he had no pain or swelling and the scar on the neck and face had entirely healed.

This patient taught us that incision of the area of cellulitis is quite unnecessary. The cellulitis can safely be left to the antianthrax serum. Excision of the malignant pustule alone seems sensible, since it prevents the spread of the disease. Nothing was gained, however, by the incision in the neck and drainage; the pus from this was always sterile as to anthrax bacillus, and the subsidence which took place was apparently not at all due to the incision, but to the antianthrax serum which was given.

CASE IV.—J. E. P., native of Minnesota. This patient entered the hospital July 5, 1918, with a diagnosis "undetermined," and left the hospital August 23d. The patient came in at 10.00 P. M., and was immediately rushed to the laboratory, where the pustule was examined bacteriologically. He said that on the morning of the preceding day he scratched himself while shaving on the right side of the face just below the lower jaw. On the following morning he noticed a pimple over the area which had been scratched. He continued working until night, when he began to complain of headache, fever, pain on

the right side of the neck, and swelling of the neck. He had not been engaged in taking care of or in handling cattle nor in any occupation bringing him in contact with furs.

On the right side of the face, below the angle of the jaw, the malignant pustule was located; it was a sore ½ inch wide with a black scab over it, emphasizing the appropriateness of the French term *charbon*. There was swelling and induration above the sore and cellulitis of the neck extending clear across to the opposite side. He had severe headache, fever, and aches and pains all over his body. The greatest amount of pain, however, was located about his jaw.

Immediately upon the finding of anthrax bacilli in the laboratory, 150 c.c. of antianthrax serum were given intravenously. He was also prepared for operation, and at 11.30 P. M. the pustule, under local anesthesia, was excised. On this occasion, owing to our experience with the preceding case, it seemed wise to do no more than excise the pustule. On the night of his entrance the temperature was not taken, but on the following morning, July 6th, at 6.00 A. M. the temperature was 102.6° F.; at 6.00 P. M. it had reached 103° F., which was the maximum. The pulse ranged from 90 to 100 on that day. July 7th the temperature ranged from 99.8° to 101° F., and pulse from 60 to 74. He complained of some pain over the left side of his face, but seemed, on the whole, to be reasonably comfortable. By the night of July 7th, forty-eight hours after entrance to the hospital, the swelling on the left side of his face, which had extended to that point from the right side, was already beginning to disappear. On July 7th 150 c.c. of antianthrax serum and on July 8th 100 c.c. of antianthrax serum were given. This was the last day he seemed to require it. On July 9th his condition was much improved, the temperature had been normal all day, and he was very comfortable. On July 19th he was so far improved that we let him out of bed, and from that time until his discharge on August 23d he had no further trouble. Like the other case, he was kept for a long time to be certain that he was ready for overseas duty before his discharge.

It is rather interesting to note in this patient's case the fact

that after the cessation of antianthrax serum therapy his pulse ranged from 50 to a maximum of 60. Indeed, his average pulse range on July 9th and 10th was 56. Subsequent to that time there was an increase in his pulse-rate. This would seem to suggest that the bradycardia which is observed both after diphtheria antitoxin and antianthrax serum is quite as much due to the serum as to the disease for which it is given.

Case V.—S. H. G. This patient entered on July 7, 1918, at 11.50 A. M., with a diagnosis of "acute infection of the face." Owing to our experience in the four preceding cases, there was no great delay, and within ten minutes the diagnosis had been made, the laboratory report showing a large number of Gram-positive bacilli resembling anthrax bacilli. He was immediately given 150 c.c. of antianthrax serum intravenously and taken to the operating room for operation, which took only ten minutes, and consisted merely of excision of the pustule under chloroform. On July 8th 150 c.c. of antianthrax serum were given intravenously and the same dose again on July 9th at 2.45 P. M. This last injection was followed by a chill lasting fifteen minutes, the temperature rising to 103.8° F. The fever rapidly subsided, however, being 101.8° F. by the next morning, July 10th, and gradually falling throughout that day. On July 11th the temperature was 98.4° F. at 7.00 A. M., and from then on he had no more fever.

The appearance of this man's face when he entered was about the same as it is in most of the cases. He had an irregular, hard, indurated sore on the left side of the face at the corner of the mouth, with a black scab on it about $\frac{1}{2}$ inch in diameter, with an indurated area about it of $\frac{3}{4}$ inch. There was marked swelling and induration about the left side of the face and neck and the swollen area was tender and painful. The patient was unable fully to open his mouth. There was much tenderness over the jaw. In addition, there was slight enlargement of the glands in the cervical region, but for the most part a diffuse cellulitis extended over the whole of the side of the neck, so that he looked like an exceedingly exaggerated case of unilateral mumps.

Convalescence in this patient was about as one would expect it to be in a case successfully treated by antitoxin or serum. On July 11th the swelling was much as it had been, but after that date the swelling very rapidly subsided. On July 18th the wound was healing and the patient was feeling very well and his condition was excellent. On July 12th he showed marked urticaria which extended over his whole body, but aside from this there were no other complications.

Case VI.—P. L. This patient entered the hospital August 5th, with the diagnosis "anthrax suspect," and left cured on September 1, 1918. [It does not seem wise to prolong convalescence of these patients unduly lest they become "hospitalized."]

This patient, an Italian, quite unable to speak English, managed to let us know that while shaving on August 3d, two days before his entrance to the hospital, he cut himself on the right side of the face over the zygoma, and by night swelling had appeared, although there was no pain or discharge. When he came to the hospital the right side of his face was much swollen. The place where he had cut himself looked like a boil with a black center and was surrounded by a great deal of induration. The malignant pustule was about the size of a quarter of a dollar. The diagnosis was promptly made, the laboratory report showing from the lesion itself a Gram-positive bacillus closely resembling the anthrax bacillus. The sore was immediately excised, this time under ether, the operation requiring only fifteen minutes. No incision was made into the cellulitis. The following day the laboratory reported that the excised pustule showed a circular, granular compact center with radiating filaments and that the smear showed thread-like chains of anthrax bacilli with their characteristic spores.

The patient was given 150 c.c. of antianthrax serum intravenously on entrance, August 5th, again on August 6th, and again on August 7th. The last dose, 100 c.c., was given on August 8th. The patient began showing improvement as early as the 7th of August. Temperature was 102° F., with a pulse of 92 on entrance, but by August 7th the temperature was normal all day long and he showed a bradycardia that the other

cases showed, his pulse ranging from 53 to 61. This bradycardia lasted for a few days, but subsequently the pulse began to rise to a more normal rate. The sore healed rather rapidly and recovery was uneventful.

This patient, on the whole, was probably the least ill of any of our cases. His highest temperature during the course of his illness was only 102° F.

The diagnosis of anthrax is, on the whole, fairly easily made. The sore is a malignant pustule and is properly so named. It appears about as malignant as the head of a rattlesnake, and on seeing it you realize that you are dealing with something inimical to life. Thus, when the laboratory man sends back the statement that culture shows staphylococci, you immediately know he is not right, and you demand another culture in order to learn the true state of affairs. But *cultures are not really the best test.* The thing to do is to take the patient to the laboratory and put a needle into the pustule itself and take from it a little pus and some serum and smear it upon a slide and stain it. The Gram-positive bacillus will be immediately found and can be identified by its size, characteristic appearance, and its spores as the anthrax bacillus. The malignant pustule is usually from $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter. There is usually a history of a very short duration of illness, with great severity of intoxication. It is so malignant that within twelve to fifteen hours after the appearance of the pustule the cellulitis has started. The pustule is almost invariably black in the center, giving rise to the French descriptive term characterizing anthrax. This black center is surrounded by very fine punctate pustules making up the aggregate of the general pustule.

Anthrax in some respects resembles syphilis in that it has a primary sore from which the disease is spread into and through the body. The malignant pustule of anthrax is the chancre of syphilis. There is only one sore. The rest of the body is entirely free from skin lesions. About the sore there is usually a very marked induration which may extend for 1 or 2 inches. In the outlying district nature makes every possible effort to cofferdam the infection by blocking the lymphatics. This leads

to an extremely marked cellulitis extending for many inches from the sore, ranging, in one of our patients, to the infraclavicular region on the right side.

The constitutional symptoms in these cases are extremely marked. The patients in all six instances complained of severe headache and constitutional symptoms resembling those of influenza or any other acute infection, these consisting of severe headache and pain in the extremities and a general feeling of prostration or malaise.

Treatment in these cases should be twofold. The first step is the immediate diagnosis, and this to be made by *direct smear* and *not by culture.* The next step is the immediate giving of from 100 to 150 or 200 c.c. of antianthrax serum, depending on the severity of the case. This should in all instances be given intravenously. It is probably not necessary to inject any of the serum about the site of the pustule, though we did that in one of our cases. The third step is the excision of the pustule itself. This can be done with ordinary local anesthesia or with a little ether. The wound should be left open. In three or four days, when the cellulitis has begun to subside under the beneficent influence of antianthrax serum, the wound can be sutured together and there will usually be prompt healing.

American literature has not very much in it concerning the treatment of anthrax. Fortunately for us, however, in this country very few cases appear, and those, for the most part, in persons handling furs or hides. Most of the cases have proved fatal largely because there was no proper treatment for them. Our own cases, in all six instances, got their infection from shaving, and there is reason to believe the rabbit hair used in the manufacture of shaving brushes was responsible. Though we made every effort at this hospital to find anthrax bacilli in the shaving brushes of the six men, we did not succeed. Perhaps the only way in which success can be attained in this direction would be to emulsify some of the hairs of the brush and inject them into the peritoneum of guinea-pigs. We had no such facilities at our disposal and were unable to cultivate the germs from the shaving brushes themselves.

Alexius McGlannan, in Musser and Kelly's Practical Treatment, vol. iv, p. 325, advises the complete excision of the focus of infection by means of a cautery, provided the operation does not produce great mutilation. If the operation should be likely to produce great mutilation, he advises the injection of pure carbolic acid into the tissue circumferential to the pustule. He states that when there is evidence of great constitutional disturbance, antianthrax serum should be given and, if possible, a blood-culture made.

In our opinion the injection of the pustular area with pure carbolic acid is quite unnecessary. Personally, I would not be very anxious to have pure carbolic acid injected into any part of my anatomy if there were any other means of combating the disease. Furthermore, I should not refuse, even though the operation might be mutilating, to have the pustule excised, no matter what its location.

The treatment of anthrax by the antianthrax serum is by no means new. It was advocated as early as 1904; and Sclavo, who has used his own antianthrax serum ever since 1898, reports a mortality of only 6.09 per cent. in 164 cases of anthrax in man. When antianthrax serum is given it should be given just as diphtheric antitoxin is given, namely, as long as it is needed, and in as great a quantity as is needed. Give at least 200 c.c. per day until the patient has gotten over the intoxication.

The prognosis in cases of anthrax depends on prompt recognition, prompt excision of the pustule, and prompt treatment with antianthrax serum. A statement by Kolmer to the effect that in his experience patients with sterile blood-culture have invariably recovered, while those with bacillemia have usually died, is really meaningless. If you wait long enough, a patient without the bacteria in his blood will get them into it, and if you wait still longer after they have gotten in, the patient will die. There is no such thing as two classes of anthrax patients, those with bacteria in their blood and those without. There is, however, such a thing as two stages of anthrax, the stage in which the germs have not yet reached the blood and the stage in which they have; and I am of the opinion that if one waited

long enough in a given case the second stage will invariably follow the first.

The prognosis in all cases of untreated anthrax is bad. It is true that a few of them have been reported in medical literature as recovering more or less spontaneously, but unless there is prompt excision of the sore and antianthrax serum is promptly administered, a fatal issue can be looked for. On the other hand, it is a fair assumption, since our last 5 cases uniformly recovered, that prompt diagnosis, prompt administration of plenty of antianthrax serum (one of our patients receiving 800 c.c., nearly a quart), and prompt excision of the sore will lead uniformly to recovery. At any rate, I feel perfectly willing to take my chances of winning the fight in the next case of malignant pustule which I encounter.

CARDIOVASCULAR DISEASES AT CAMP BEAUREGARD, LA., FOR YEAR ENDING SEPTEMBER 15, 1918

By Major Donald J. Frick, M. C., U. S. A.
Chief of Medical Service

In reviewing the cardiovascular diseases at this camp it has not been the object to show by a review of vast numbers the prevalence of heart conditions, or cite rare cases, or give any startling statistics as to cure or repair of these damaged hearts. Being interested in heart conditions, the paucity of material was evident from the beginning of my stay here, and the reason for that condition in the South has been of great interest. To begin with, we may dismiss careful segregation before admission to the army as a reason for the small number of organic heart conditions. If we did this we must hold that most of the examiners were heart specialists and, therefore, incapable of detecting gross pathologic conditions in other portions of the body.

Since the hospital has opened we have had 264 cases that were diagnosed "heart disease" either primarily or secondarily. The table given on page 602 shows the total number, with their final disposition.

Of these 264 cases, 94 may well be classed as organic; the other 172 were functional, 139 of them being true cases of irritable heart.

The small number may be better emphasized by the statement that these organic heart cases averaged 5 per thousand admissions to the hospital; the functional, about 8.8 per thousand. Of course, not all the heart cases have entered the hospital as shown by the records of the Disability Board. Of the first 1000 cases discharged on Surgeon's Certificate of

CLASSIFICATION AND DISPOSITION OF CASES OF HEART DISEASE IN BASE HOSPITAL, CAMP BEAUREGARD, LA., FOR YEAR ENDING SEPTEMBER 15, 1918

Classification.	Duty.	S.C.D.	Transferred.	Died.	Total.
Mitral insufficiency	41	13	0	0	54
Mitral stenosis	9	2	0	0	11
Aortic insufficiency	3	4	1	0	8
Valvular heart lesions	8	1	0	0	9
Myocarditis	2	1	0	0	3
Heart disease, congenital	0	1	0	1	2
Endocarditis	0	0	0	1	1
Pericarditis	2	0	0	4	6
Pulmonic lesions	0	0	0	0	0
Cardiac hypertrophy	6	1	0	0	7
Arhythmia	5	0	0	0	5
Tachycardia	9	0	0	0	9
Cardiac disease, functional	7	1	0	0	8
Neurocirculatory asthenia	88	48	3	0	139
Paroxysmal tachycardia	2	0	0	0	2
Total	182	72	4	6	264

Duty = Return to full duty, domestic service (with guard duty), or light duty (without guard duty).

S. C. D. = Discharge on surgeon's certificate of disability.

Transferred = Transferred to special hospital for further treatment.

Disability from Beauregard there were 46 heart cases, distributed as follows:

Mitral insufficiency	34
Mitral stenosis	1
Aortic insufficiency	3
Arteriosclerosis	6
Cardiac enlargement	2

Of 121 cases of this first 1000 discharged on a diagnosis of psychoneurosis there is no question but a certain number were cases of neurocirculatory asthenia, no study having been made of these cases until late in April, about two months after these 1000 discharge cases were analyzed.

The practical absence of arhythmias noted is, of course, not surprising, as you would hardly expect in the army age (twenty-one to thirty-one) many cases with sufficient pathology in the heart muscle to give permanent irregularities. Sinus arhythmia

is exceedingly common and cases with premature contractions are not rare; because of their lack of significance among otherwise healthy men no record has been kept of the absolute frequency of such conditions. One case of mitral stenosis had a period of eight hours of fibrillation of the auricle. At the end of the period the heart-beat became regular and remained so during a period of two months' observation in the hospital. No cases of heart-block, auricular flutter, or alternation have been reported.

The tachycardias seemed to be of three types. Those following acute infectious diseases; these with two exceptions gradually slowed down and the patient became fit for duty. A second type—associated with the syndrome neurocirculatory asthenia—will be discussed more fully later. Two cases had distinct periods of paroxysmal tachycardia with premature contractions, probably of ventricular origin, between the attacks.

Cases of high blood-pressure are rare; 8 cases have been noted with pressure over 160 (systolic). This, of course, does not include officers who have been in the wards or appeared for examination.

On account of the discussion as to whether these neurocirculatory asthenia cases are not due to thyroid intoxication it seems well to record the fact that thyroid involvement is practically unknown in the region from which the bulk of these troops came—Mississippi, Arkansas, and Louisiana. In the first seven months of the existence of the hospital one doubtful case was seen. Since that time there have been 15 cases either admitted or sent for examination to the hospital. All of these cases were sent down to Camp Beauregard from Camp Taylor, and had been recruited from northern Ohio and Indiana. The southern physicians on service here at the hospital concur in this opinion that diseases of the thyroid are unknown in this section. On the other hand, 90 per cent. of the cases of neurocirculatory asthenia came from the extreme southern states.

The rarity of organic lesions of the heart is due, in my opinion, to the few cases of streptococcus infection in the southern men. They rarely give a history of tonsillitis, and acute infec-

tious arthritis is most uncommon. Great numbers of them complain of rheumatism, but from a rather close study we feel that most of these cases are due to weakened muscles and bad posture. Rheumatism as a result of gonorrhea is a very common complaint, but the lesions do not bear out their statements. On account of the danger from overstrain all cases of true organic heart disease have been or should be discharged from the army. Only about 10 per cent. of these cases needed any treatment except relief from heavy bodily exertion; 90 per cent. of them stood exercise of any kind much better than the functional heart cases.

The large group of cases, 139, which have been definitely classed as neurocirculatory asthenia have held out great interest for us all. After studying them for six months, placing them under the best conditions as to food, rest, and exercise, the most skeptical of us have come to the following conclusions:

1. That it is absolutely useless to take any of these cases into the army. The syndrome should be taught to all examiners, and when recognized should be a cause of immediate rejection.

Of the 139, 88 were returned to some type of duty, 10 to full duty, and the other 78 to duty in Class B or C; 48 have been discharged or recommended for discharge. This after months of patient care in the hospital and individual trials with the exercises of Lewis as given in Hempstead Hospital. The cost to the government and the time of the physicians would hardly seem to be compensated for by the result obtained, as none of us felt very sure that even the 10 would "carry on" if put under any marked strain.

2. Our experience with treatment of these cases has proved of no avail as far as cure is concerned, and with no appreciable improvement except in mild cases. We followed strictly the method of Lewis, using his exercises B 15, C 15, C 15 second part, and D 30, with periods of rest and good food.

3. The exercises gave us a basis of classification which could not have been obtained in any other way. The capacity for work can be the only criterion for these cases.

4. These cases are seen only in the army or in places where examination is compulsory, because if left to themselves they are able to adjust their lives to their ability to do work. Their histories almost universally show that they have been failures or near failures because they could not stand work. Most of them have no physical pain or distress and are shy and retiring, and so would not voluntarily see a physician. If they did, he would examine them at rest when the pulse may be around 70 or 80 and give no indication of anything unless stimulated.

5. Approximately 80 per cent. of these cases used tobacco to excess. We have no means of knowing accurately their habits as to alcohol or their tolerance to it.

6. The average blood-pressure of the cases studied was slightly high for the age incidence—systolic 132, diastolic 90.

7. The pulse-rate varied markedly. The mild cases averaged 90 at rest, 130 after exercise, dropping to 100 in two to three minutes; the moderately severe, 110 at rest, 140 to 160 after exercise, dropping to 110 to 120 in two to three minutes; the severe, 130 to 140 at rest, 160 to 190 after exercise, with no return at end of five or six minutes.

8. Sixty per cent. of these cases have a family history showing nervous or mental instability.

9. All the severe and moderately severe cases had histories of many infections, and the condition having existed for three to twenty years.

10. A patient must have a majority of the symptoms enumerated below—a rapid heart, pain over the precordia, tremor of the hands, dizziness, shortness of breath on exertion, and cyanosis of the extremities—before a diagnosis of neurocirculatory asthenia could be made. Most of them could be diagnosed at a glance after exercise; their expression of agony and desire for breath is one of the classical pictures of medicine.

11. None of the races down here have been exempt—French, Scotch, Spanish, English, and even the negro have given us examples. Most of the cases, however, have been among the "Cajens," who are numerous in this region.

12. We have classed these as heart cases and discussed them

as such, but with a good many misgivings. In bed, after a night's rest or when the nurse takes their pulse when at rest, the rate may be between 70 and 80. Mental excitement, sitting up in bed, walking, anything that puts these creatures on a strain, immediately brings up their pulse. They are not of any particular build and may be muscularly well developed. Left to themselves to go their way, they have no distress.

13. After examination of this series, reading the admirable articles of Lewis, Francis Fraser, Oppenheimer, Rothschilds, and the reports from the many camps in this country, one is constrained to decide that these cases are true neuroses on a toxic basis usually of long standing. Unfortunately we have not the time to work out each and every one of them and still win the war.

The most of the material for this paper was obtained by Lieutenant Alfred Lewis, assisted by Lieutenant Fred Smith, who were given one of the wards holding about 56 patients (in the ward and on the porches). This was called the cardiovascular ward, and all cases for heart examination or treatment were sent to this ward. All true cases of heart disease were admitted and a preliminary study begun. After a week or ten days ambulant cases were sent to the cardiovascular ward in the convalescent camp, which was under the supervision of these same officers. Exercises after the plan of the Hempstead Hospital, as outlined by Lewis, were carried out night and morning. These were at first given by the medical officers, but they were soon able to instruct sergeants in the exercises, and merely supervise and watch results. The withdrawal of both these men from the department within a few weeks of each other and constant shifting of personnel since has made further work along this line impossible.

The work as outlined gave valuable information, and is the only possible means of gaining accurate data for prognosis in heart conditions in the army.

DRUG ADDICTION

By Major J. M. W. Scott, M. C., U. S. A.

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September 18, 1918.

Experience at Camp Lee shows that freeing a man from morphin addiction is an easy proceeding; and the excuse for this paper is that so many look upon drug addiction as some occult, mysterious condition, showing absolute degenerate or degenerated moral fiber and moral turpitude. It is further believed rather widely that the addiction produces in the tissues real, permanent organic changes (chemical or microscopic, or both), and that these conditions can never be cured, or require fantastically long periods for recovery or even partial correction and that excessive and almost unendurable suffering must accompany the treatment. In short, the idea is that practically all cases are hopeless and not worth effort. This is an entirely unreasonable attitude, and not borne out by the medical facts in the premises.

The work was done on the theoretic lines set forth by Dr. George E. Pettey in his book "Narcotic Drug Diseases and Allied Ailments," and the practice developed was the result of the experience gained, the conclusion that hyoscin and allied drugs are not indicated, and that it is a mistake to use them, being the most notable change.

This paper will particularly deal with morphin addiction, as it is the really important drug. Cocain, chloral, the coal-tar products, and the rest are always possible to manage without very special care, as their actions on the system are of a different type. One deals with their direct poisonous effects, not with the secondary consequences. Addicts who take various drugs can rather easily suspend the use of the rest, but morphin is too much for them.

Morphin dulls sensation and sensibility and interferes with the normal reactions of the body, interferes with its activities, blocks excretion, inhibits or even suspends the peristalsis of the bowels, so the feces are retained unduly long, and a great increase in the quantity of autotoxins in the body occurs. While at rest they are relatively harmless, and the attempt is made to keep them so by repeated doses of the drug. There have been people where the amount used was held at a moderate point, who have gone on for years taking morphin, and living rather full and active lives, although always limited and handicapped by their addiction. Such examples are rare, the rule being that body routine and metabolism are so disturbed that the quantity used is increased steadily, the general health impaired, anemia developed, efficiency and dependability destroyed.

The practice of drug using is established as a form of running away on the part of the victim or his physician, or develops as a consequence of association with habituates.

The individual uses it to get relief when uncomfortable in any way. Physicians prescribe it sometimes as the easiest way of handling a case, either because of laziness or carelessness, or because of ignorance. It often saves the effort necessary to properly diagnose and treat a patient.

Many have started because associates persuaded them to try the effects. Certain pool-rooms and other rendezvous have really been schools and centers for the development of habituates. Sometimes drugs are used by acrobats, dancers, and other stage people with the idea that it will enable them to put more force, vivacity, and effectiveness into their acts, in spite of the long irregular hours of effort, hard railroad journeys, and frequent loss of sleep. Sometimes the condition has been developed in individuals who heard of the stimulating effects of the various drugs and found the action from alcohol too slow. The habit may develop in normal persons, and such constitute probably 75 per cent. of the cases, but, of course, it is readily recognized that one of poor psychic fiber is much more susceptible to the discomforts and temptations that lead to the formation of the addiction, and much more apt to relapse

after being freed from the disability. If one much prefers being an addict to being free, the only thing for him is to be under the control of some authority outside himself. Any one will develop the habituation in a short time (say a month) if the drug is used in appreciable dose and with frequency.

Hyoscin, scopolamin, atropin, and other drugs of this group are suggested and used in the various sanitaria and cures, and are advocated by Pettey, but the writer's experience with them was not happy. They are the physiologic antidotes for morphin-poisoning, but that is not the condition that obtains in addicts. Of all the cases seen in Camp Lee there was but one case of poisoning, and that man, as a final fling, had taken two or three times his usual dose, if not more. (It was not possible to get an accurate, reliable statement from him.) Pettey uses these drugs after the morphin has been withdrawn, others advocate them as almost the whole reliance. The writer's experience is that when the condition comes that is usually met by giving hyoscin, it is absolute evidence that the man needs morphin. A dose or two will restore the even tenor of events, and no drug and no combination of drugs that does not contain morphin will do so. Hyoscin will knock the man out, confuse him, dry his throat and mouth, make him feel miserable in addition to what he is already suffering from the morphin deprivation; and, often, will make him delirious and hallucinated; all of which is unnecessary and cruel and subjects the system to great and unwarranted strain. If hyoscin is given, insult is being added to the injury of refusing the drug before the body is prepared for its orderly and proper withdrawal.

As above stated, morphin blocks excretion, and one is dealing with auto- and intestinal toxins, and their elimination in large part is proper before morphin is suspended: as otherwise, as soon as the primary effects of the drug wear off nature tries to remove them too rapidly. These toxins are probably no new combinations to which the body is unaccustomed, but simply the usual waste products which have accumulated in unusual quantity. As soon as they are eliminated the body takes up its functions again, and there is nothing occult or weird, and no

great organic change. Deprivation symptoms include fever, usually moderate, but it may run very high. It probably occurs in all cases where the drug is suddenly withdrawn, except in those cases in which severe diarrhea gives the hint from nature as to the best and most rational treatment. It is noticed that when the bowel action is most free the patients pass through the withdrawing period most easily.

Other symptoms are diarrhea, abdominal colic, nausea, vomiting, extreme pains and aches in the muscles and bones (legs most complained of), malaise, prostration, headache, insomnia, sweating, restlessness, weakness, rapid and weak heart action, cyanosis and respiratory embarrassment, and intense feeling of suffering and inability to endure, as if from grip or other acute infection. The condition may readily become alarming, and death can easily occur.

Each case must be treated individually and as carefully as a case of pneumonia, no standing orders or routine practice being effective. One great objection to some of the cures is that the whole thing is routine and the effects unbalanced and often cruel, entailing much unnecessary suffering.

When the patient is first seen some little history is obtained as to how much he is taking, in what manner, what dose, and at what interval, and when the last dose was taken. How long the addiction has lasted is not important, as the reactions are nearly the same in any case. The general condition is estimated, especially as to elimination, and particularly as to the alimentary canal, most attention being given to the tongue and habits as to defecation, and the time of the last movement is important. If he is fairly comfortable, the tongue clean, and the bowels free, there may be no need of any morphin in this case. All are given tincture of nux vomica (10 minims or 15 drops in water every hour), beginning at once. This stimulates peristalsis and the system generally, replacing the stimulating effects of the morphin, and counteracting the auto-intoxication depression. The interval is lengthened gradually as conditions warrant, the hourly dose being used two or three days. If the nux is continued too long there appears a peculiar

irritated nervous state and gastric derangement not otherwise noted. Care should be taken not to overmedicate, but in the early stages of the treatment the dose of nux indicated is not too much, and it is hardly possible to get overcatharsis.

If the bowels have not been freely moved, an enema is given at once and an emptying of the colon secured. If no morphin has been taken for three or more hours and none is at once demanded, a cathartic is given at once. The dose must be ample. No ordinary standards of dosage, nor frequency of evacuation, nor fulness of movement will serve. There is the effect of the morphin in inhibiting peristalsis to be considered (that is why an interval after the receiving of morphin before the giving of the cathartic is necessary), and griping need not be feared as much as in the ordinary patient, the same reaction in this respect not being shown. The cathartic must be effective. Calomel seems to have a helpful antiseptic effect, as is so often noted in toxic cases. To get the best results in the majority of instances compound cathartic pills were found very efficient and satisfactory. Castor oil for one dose, to get a rapid cleansing of the canal, has sometimes been used, but is generally not oversatisfactory even for this; and is sometimes very disappointing, as there may be no movement. Calomel, followed by a saline, is also unsatisfactory, as the salts do not have a sufficiently continuous effect and do not seem to act enough on the full length of the canal. Do not fear there will be prostration if the bowels move very, very freely. The thing that prostrates is the toxins and there will be prostration if the bowel action is ineffective, not if there is excessive action. This condition is absolutely needed to get the poison from the body in time to keep the system clear and avoid deprivation effects, *i. e.*, auto-intoxication to an excessive degree. Anywhere from five to six large movements every twelve hours to almost continuous action will keep him most comfortable, and this is necessary, as the bowel contents are nine times as poisonous as the urine, and the intestines provide the only efficient and at all adequate means of cleansing the body. If successful in keeping the waste products eliminated, so there are not

too many moving at one time, the patient will suffer very little.

The dose of the compound cathartic pills is two to four, usually four, for the first dose, and three or four for the subsequent doses, from four to twelve being taken every twenty-four hours. The great difficulty in teaching the method to inexperienced men is to have the cathartic given in sufficient quantity and at frequent enough intervals. There is always the idea that the man should have a good night's sleep. This is appropriate to a later stage in the cure, but it is much better that the first twenty-four hours be spent almost entirely in emptying the bowels. The patient is very much more comfortable, gets on much faster, and shows a much better condition after the drug has been withdrawn; and, naturally, recuperates much more quickly. It is not to be expected that he will sleep much for forty-eight or seventy-two hours, and sometimes it is a long time before the sleep is perfect. This is very unusual. As soon as the toxins have been nearly eliminated the body functions are promptly resumed in a remarkably satisfactory manner.

If when first seen the man is suffering with deprivation symptoms, a dose of morphin ($\frac{1}{4}$ grain, less often $\frac{1}{2}$ grain) is given by hypodermic. This method is used because the amount employed is readily controlled, the patient cannot tell how much he is receiving, and one avoids the feeling of dissatisfaction encountered if the patient feels an inadequate dose is being given. If the man becomes hysteric, as sometimes occurs, and demands morphin when none is needed, it is also possible to use sterile water.

If relief is not experienced in a short time (half-hour or an hour) the dose is repeated, or a larger or smaller one given, as seems indicated in the judgment of the medical attendant. Each dose is made the subject of a special investigation and order by the physician, absolutely no routine procedure being permitted. Each case must be followed and handled individually and attentively.

No more is likely to be needed for at least six or eight hours,

and none is given unless indicated. It is not often that more than three doses altogether are required.

On the other hand, it is to be remembered that the man has been using morphin and there is no danger of producing an addiction, as that is already present, and a little morphin will not hurt him, as he is accustomed to a great deal. Generally, also, two or three days are not going to make any real difference. It is better to take sufficient time to conduct the removal rather comfortably, and not subject patients to the discomfort (really, better, misery) and extreme depression caused by refusing the drug when it is really needed, the consequent exhaustion sometimes becoming a very important factor and causing more delay in the long run.

They are not hungry for some time (one to three days), and it is well that they should not eat at first, as the body is sufficiently busy on elimination, and the mucous membranes are generally covered with catarrhal secretions, so that digestion is difficult or impossible. Some light liquid diet is sometimes indicated.

Suddenly, however, they become hungry, and then it is well to force the feeding as much as conditions will allow. Sometimes it is really quite a problem to give enough nourishment to rapidly build up the patient without causing indigestion, but this is usually not noted. They are generally undernourished, and easily digested and simple foods are demanded. This does not mean prolonged use of liquids. The best results were obtained by the use of solid, but simple food.

As soon as improvement comes and the man is free from the drug he will want to be out of bed and getting about. This must be strictly controlled. They must be treated as if there were an acute disease like pneumonia (and in a sense there is) and not allowed too much liberty at first.

When the strength is returning, exercise and work are of the first importance, and should receive very special attention. Hot and cold baths and, if pains in the body persist, prolonged hot baths help, and during the first part of the cure they are sometimes indicated to control restlessness and the aches and pains.

It is not fair to take a man off his drug and then leave him not prepared to really meet his situation in life. All possible ingenuity and means must be employed to get him into condition. This paper refers especially to correcting the addiction, and it is not desired to prolong it with after-treatment, nor cloud the main points with outside matters. As in all things, the man must be treated rather than the disease, and each physician has his tried methods, which will indicate the required action after the addiction is corrected.

If any one thing recommends itself for use in all cases, it is suitably regulated setting-up exercises twice a day.

The ease of withdrawal is graphically illustrated by a particular case. This man had some tubercular fibrosis of the lungs, hemorroids, fistula in ano, and was developing an ischiorectal abscess. When he first came into the ward a start at withdrawal was begun at once, before minute examination had established all these infirmities. He was running some fever and was partly delirious, so it was not possible to keep him in bed without someone sitting with him all the time, and his heart was acting poorly. It was decided that he was in such poor condition that it would not be wise to try to correct the addiction, so the attempt was given over. At the same time, however, he was given the best treatment available for his general condition. His bowels were kept open, other medicine was administered as indicated, and the morphin was exhibited whenever circumstances required it. He did not need a dose very often, and inside of three or four days it was noted that the intervals between doses had lengthened out until he was free from the addiction one might almost say by accident and through pure carelessness.

The patient should be in a sanitarium or suitable hospital when the drug is withdrawn. When at large he is without control and the results are disappointing. Failure and discrediting of the method and the physician may be expected if it is tried under any other conditions.

Some may ask what kind of soldiers these men made. They were sent to their organizations as soon as it seemed at all pos-

sible they could stand the drill. The active regular life was entirely to their advantage, and also the simple rather coarse food, which is, of course, best for most people. A few returned to the hospital again and a few relapsed; but most of them made good soldiers, and some made excellent soldiers.

Addicts as a class are usually undisciplined and the army life is a great advantage to them, and they learn that one's whims and transient feelings are not the important things in the world. Too long a tarrying in the hospital tends to break down their morale, so the time of discharge requires judgment to avoid too quick a return to active life and to avoid too slow a return. The environment to which he goes is to be taken into consideration in deciding. In the army the immediate commanding officer is important, as where discipline is best relapse is less likely to occur.

After one is freed from the addiction there are a few facts that should hold his attention and control his conduct.

If he allows himself to become worried or run down, or loses a great amount of sleep or greatly overworks, there will be great risk that he will again take up the use of the drug.

Also, if he uses alcohol in any form, the resumption is almost positive.

Tobacco often leads to relapse, coffee and tea are dangerous, and caffein-containing "soft drinks" will often lead to the re-establishment of the difficulty.

Even if the percentage of men regained were much smaller, there would be ample satisfaction in the treating of drug addiction cases, especially in view of the simplicity and effectiveness of the plan recommended. It is hoped these lines will lead to the intelligent treatment of more cases and that it will become a disgrace to neglect them.

MARIE'S DISEASE. INFANTILISM. HYPERKERATOSIS. SUBCLAVIAN ANEURYSM

By First Lieut. Macy L. Lerner, M. C., U. S. A.
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CHRONIC HYPERTROPHIC PULMONARY OSTEO-ARTHROPATHY

This case was in a negro, who gave a history of an acute infectious jaundice of infancy. There were no detectable pulmonary or cardiac disorders. The distal phalanges of the

Fig. 124.—Chronic hypertrophic pulmonary osteo-arthropathy.

hands and toes presented a most marked spatular enlargement, with typical cyanosis, also curving and ridging of the nails. This is well illustrated in Figs. 124 and 125.

Fig. 125.—Chronic hypertrophic pulmonary osteo-arthropathy.

INFANTILISM

Three typical cases of infantilism were diagnosed by the medical examiner; two of them were photographed on consent of the men. All cases showed arrest of development of sexual organs in different degrees; however, they were all characteristic and typical infantile cases. All cases had the general effeminate contour of the body, rather broad pelvis, with a suprapubic pad of fat, giving the characteristics of a mons veneris (Fig. 126).

Every case had a distinct transverse pubis hair line.

The hair distribution of the body, genitalia, face, and axillary pits was rather sparse.

Genital Organs.—Penis in 2 cases was about 1 inch in size; in the third case penis was about $1\frac{1}{2}$ inches in size. Glans penis was acorn shaped. Testicles in all cases were the size of a pea. In two of them a history was given of never having any sexual desire and never manifesting any sexual activity. The third man stated that he had occasional erections, but no emissions, also that he had occasional intercourse.

All three men expressed a wish to marry, believing that matri-

Fig. 126.—Case of infantilism.

mony might stimulate their sexual activity. Their voices were feminine and high pitched.

HYPERKERATOSIS

This case was in a white enlisted man, whose general condition was otherwise good, with the exception of uniform callosities over the entire palms of hands and soles of feet. The callosities were hard and caused considerable pain of hands and feet.

TRAUMATIC ANEURYSM OF FIRST PORTION OF LEFT SUBCLAVIAN ARTERY

This case was in a negro aged thirty-two, weight 140 pounds, occupation laborer.

Personal History.—Man had had pertussis, scarlet fever,

diphtheria, rheumatic fever, tonsillitis, typhoid fever, malaria, and a history of a chancre.

Habits.—Smokes cigars and cigarettes, also chews, all in moderation; uses alcohol to a slight extent.

Symptoms.—Gives a history of pain, dyspnea, palpitation, cough, giddiness, and sweating.

Physical Examination.—General appearance good. *Heart:* First sound somewhat harsh; faint systolic murmur heard at the second pulmonic, not transmitted. Apex in fifth interspace, in normal position. *Pulse:* Radial pulse on right side somewhat stronger than on the left.

Blood-pressure.—On the right arm, 140 systolic, 88 diastolic; on the left, 136 systolic, 88 diastolic.

Location of Aneurysm.—A scar was seen over the inner third of the clavicle, which is due to a bullet wound, as stated by the man. A loud bruit, metallic in character, was heard distinctly at the sternoclavicular junction, transmitted somewhat to the left below the clavicle and also to the left supraclavicular region, into the neck. No expansile pulsation noticed over that region.

The fluoroscopy of the heart and upper vessels, taken at the Camp Hospital, confirmed the diagnosis of an aneurysm of the first portion of the left subclavian artery.

THE CLINICAL SIGNIFICANCE OF CARDIAC MURMURS[1]

By Major Thomas D. Coleman (Augusta, Ga.), M. C., U. S. A., and Captain Emmet F. Horine (Louisville, Ky.), M. C., U. S. A.

Camp Hancock, Augusta, Ga.

A cardiac murmur or bruit has been defined as an adventitious sound which precedes, takes the place of, or follows a normal heart sound. Much confusion exists in the medical mind concerning the significance of cardiac murmurs. There are many who regard any type of murmur with grave suspicion, as being indicative of a serious heart defect. Other men advise that murmurs be disregarded entirely unless there be other symptoms. We believe it is true that a grave prognosis is not indicated with the majority of murmurs, but we feel that they should not be completely ignored. The prognosis rests not so much upon the type of murmur as upon the integrity of the myocardium. However, certain types of murmurs, as will be pointed out later, must be considered as having a very definite bearing upon the ultimate prognosis.

In examining large numbers of men it is surprising how many cardiac abnormalities are encountered. Murmurs of various types; accentuations, reduplications, and thrills are frequently discovered singly and often without clinical significance.

It cannot be too strongly emphasized that a murmur, *alone*, is not evidence of organic heart disease. Many murmurs are produced by conditions other than valvular impairment, and this fact must be kept constantly in mind. A murmur may or may not be an important symptom, and the physician must consider every correlated finding in order to properly interpret it. We have records of many patients who have been forced to

[1] The basis for this paper embodies the work carried out in the examination of 15,647 men. Of these, 1851 were examined by Captain Horine in the Base Hospital and 13,896 appeared before the Camp Hancock Cardiovascular Board.

spend years of inactivity because of the chance discovery of a murmur which caused the examiner to give a grave prognosis, and to prohibit any except the very lightest exercise. These patients have gone through years of mental torture, firmly believing that any exertion might lead to sudden death. Thus they have become partial physical wrecks, and, as their general musculature has suffered from partial disuse, so has their cardiac musculature.

In this brief paper we shall endeavor to consider only endocardial murmurs. The time-honored classification of these murmurs, organic and inorganic, will be used. Organic murmurs are due to permanent changes in structure of the valve leaflets or orifices. However, organic murmurs may be present without myocardial change, in which case they are relatively benign unless diastolic. Even diastolic murmurs may be present for years and give rise to no untoward symptoms, provided the myocardium be uninjured. This fact may be best illustrated by briefly reviewing one of several cases of this nature which has been observed by us.

A spare, fairly well-developed man, twenty-eight years of age, by occupation a chauffeur and mechanic, was brought to us for examination. He was 69 inches in height and weighed 120 pounds. His personal history is as follows: Repeated attacks of tonsillitis with cervical adenitis until about twelve years of age. There were no other diseases during boyhood and he was always very active. When twenty-one years of age he contracted pneumonia, was in bed for three weeks, and confined to the house for an additional three weeks. He states that he was "helpless, with severe pain in the muscles of the arms, legs, and back while sick with pneumonia." Since then he has been able to continue his work, although he complains of palpitation on severe exertion. He denies having had any venereal disease. He takes from one to two glasses of beer daily and smokes an average of fifteen cigarettes.

The physical examination revealed the maximal cardiac impulse under the fifth rib, 6.5 cm. to the left of the midsternal line. The impulse was slightly diffuse and heaving in character.

Percussion demonstrated the transverse diameter of the heart to be 11.5 cm., and this finding was later confirmed by a teleroentgenogram. The pulse was normal in rhythm and slightly collapsing; the arteries were not infiltrated, and the radials were equal. The pulse-rates were: Standing, 100; recumbent, 88; after hopping 100 times on one foot, 138; and two minutes later, recumbent, 100. Subungual capillary pulsation was present, being particularly marked after slight exercise. The blood-pressure findings were as follows:

	Right brachial.	Left brachial.	Femoral.
Systolic	128	124	156 mm.
Diastolic	56	54	54 mm.
Pulse-pressure	72	70	102 mm.

Auscultation revealed the presence of a blowing systolic apical murmur transmitted laterally toward the left for a distance of 6 cm. This murmur replaced the first sound at the apex. A diastolic murmur was also heard, with the point of maximal intensity at the costal cartilage of the fourth rib to the left of the sternum. The diastolic murmur was transmitted for a short distance in all directions. The second sound at the base was practically replaced by the murmur, which was blowing in character and occupied rather more than the first half of the diastole. A double murmur could be distinguished over the femorals by careful manipulation of the stethoscope.

The Wassermann reaction was negative.

In the case just reviewed there were undoubtedly two organic lesions—aortic and mitral insufficiency dating back at least seven years. Yet the transverse diameter of the heart was normal and there was a fairly good exercise response. However, this man had been engaged in light work and thus he protected his myocardium. With the continuance of light work, involving only a moderate amount of physical exertion, he probably can go on for years. But in time the myocardium must begin to suffer from a somewhat restricted blood-supply; this, in turn, because of an inadequate coronary circulation. The myocardium is supplied with blood immediately after the clos-

ure of the aortic valves and while the pressure in the aorta is greatest. Normally this peak pressure is gradually reduced, thus favoring perfect filling of the coronary arteries. In aortic insufficiency the pressure falls rapidly and reaches a lower level than normal. The rapid decline in pressure must result in imperfect filling of the coronary arteries, and with this, as a natural sequence, undernourishment of the myocardium.

The case just reviewed illustrates a temporarily benign aortic condition. At the same time we have endeavored to show why a grave prognosis should be given. We shall now consider the diastolic or so-called presystolic murmurs heard at the apex and originating at the mitral orifice. Experience has taught that mitral stenosis is a progressive condition. With the appearance of the presystolic thrill, the presystolic roll, snappy mitral first sound, and accentuation of the second pulmonic sound we have a group of symptoms absolutely diagnostic. Even with a small degree of stenosis considerable strain is placed upon the auricle. Subjective symptoms, such as dyspnea and palpitation on slight exertion, become noticeable. As contraction of the fibrous tissue in and around the orifice becomes more marked the subjective symptoms increase, and, objectively, the murmur becomes longer and considerable irregularity develops. This irregularity is out of proportion to the subjective symptoms. Primarily, there has been a hypertrophy of the auricle, but, as the stenosis has become more marked, the auricle gradually succumbs to the strain and begins to fibrillate. Further, as the stenosis becomes more marked, the ventricle is incompletely filled and coincidently the body is improperly supplied with blood. The cardiac musculature suffers in a like manner. Thus we see, in both aortic insufficiency and in mitral stenosis, the end-result is an interference with the coronary circulation and consequent myocardial changes.

Inorganic murmurs are frequently divided into two rather ill-defined classes: (1) functional; (2) accidental. There is considerable disagreement among writers as to what constitutes these two types. Jacobi has proposed that accidental murmurs include all those sounds produced outside the heart, such as

friction-rubs, either pleuropericardial or pericardial, and the impact of the heart against lung tissue or the chest wall. Under the term "functional" he classifies all endocardial murmurs not accompanied by change of structure. Babcock apparently considers these terms "accidental" and "functional" as synonymous. However, he states that "such a murmur, even though transient, signifies something more than a functional murmur." Cabot considers the terms "functional," "accidental," and "hemic" as synonymous, although he states, "the connection between anemia and functional heart murmurs is by no means as close as has often been supposed."

It is questionable as to whether any murmur should be classed as a hemic one. If altered blood statescould be productive of murmurs, it would seem that at least every case of pernicious anemia should be accompanied by murmurs. Yet we have seen many cases of pernicious anemia and several with erythrocyte counts under 1,000,000 unaccompanied by murmurs. We are sure that, as the result of the anemia and general muscular weakness, the cardiac musculature also suffers, and relative insufficiency must occur in a certain percentage of cases. But the altered condition of the blood *per se* is not productive of murmurs.

Sir James Mackenzie suggests that the term "physiologic" be used for those murmurs found in healthy individuals who "lead strenuous lives and never show any sign of heart failure" or heart impairment. His assumption that a murmur may be a normal or physiologic finding is based on the fact that many healthy young people are found with murmurs. However, it has not been demonstrated among adults that the percentage of murmurs found is sufficiently high to justify the term "physiologic." Luethje, Beyer, Gerhardt, and other observers have found murmurs in school children in percentages ranging from 27 to 56 or even 72 per cent.. but such high percentages have never been found in adults. Is it not highly probable that the majority of murmurs found in young people are really *functional* and due to relaxation of the orifices or other non-organic changes brought on by exercise or excitement? Our own experience not

only in young people, but also in adults, seems to suggest very strongly the conclusion that we cannot call any murmur physiologic. We feel that the sounds of a normal heart should be clear cut, subject, of course, to certain slight variations. Every endocardial murmur is abnormal and falls into one of three classes: (1) Organic; (2) functional; (3) accidental.

It is unfortunate that such terms as "accidental" and "functional" have been admitted to cardiac nomenclature, and, particularly, since there is no unanimity of opinion concerning them, but we have no desire to add further confusion by attempting to suggest other terms to replace them. It would seem that the best plan would be to retain these terms and to attempt to classify definitely all non-organic endocardial murmurs accordingly. We believe the term "accidental" can be safely used to include certain endocardial murmurs to be described later.

Functional murmurs are transient and indicate some disturbance of the heart caused by varying degrees of relaxation of the myocardium or incomplete emptying of the ventricles. With functional murmurs there is no organic change in the valve leaflets or orifices, although there may be marked changes in the myocardium. It will thus be seen that we have organic murmurs without myocardial change, in which case the condition is relatively benign; or we may have functional murmurs associated with myocardial changes of great severity. The murmur, in either case, is merely a symptom which suggests the necessity for making a careful investigation.

An interesting type of functional murmur is one encountered in perfectly healthy men during active training. No murmur will be detected on examination either in the erect or in the recumbent posture before exercise. Immediately after the customary exercise test of 100 hops on one foot, there will develop a blowing apical systolic murmur which even may replace the first sound. Usually there is slight lateral transmission toward the left, and in two instances the murmur has been transmitted as far laterally as the midaxillary line. Within from thirty to sixty seconds after exercise the murmur will begin to grow faint

and will disappear in from two to three minutes. The explanation for such a murmur would seem very simple, being merely dilatation of the musculomembranous ring of the mitral orifice, resulting in imperfect coaptation of the valvular segments.

We have also observed functional murmurs appearing during convalescence from various infectious processes, and occasionally following operative procedures. Such murmurs are systolic in time and are heard usually at the mitral area in the erect posture; becoming faint or entirely disappearing in the recumbent posture. Frequently, after slight exercise, this type of murmur will disappear entirely. After more strenuous exercise the murmur may reappear. The probable explanation here is that primarily there is a slightly relaxed mitral ring, which, after the stimulus of the slight exercise, contracts. Later, after a greater amount of exercise, there is subsequent relaxation of the ring and a reappearance of the murmur.

Also, systolic murmurs are seen frequently in the pulmonary area and occasionally in the aortic. Judging from the evanescence of such murmurs and from the fact that there is a normal or fairly good response after exercise, such murmurs necessarily must be classed as functional.

The systolic murmur observed in the pulmonary area occurs more frequently than any other murmur. It may occur in the debilitated as well as in the perfectly healthy individual. Its mode of production is still undetermined, though some change in the conus arteriosus or pulmonary artery probably causes it. It can readily be seen that relaxation of the pulmonary artery just outside of the valve would result in a relative stenosis and the production of a murmur. At times pulmonary murmurs are heard only in the recumbent posture, and a possible explanation of this occurrence is suggested when we consider that the weight of the heart may drag the pulmonary artery downward and backward and cause a murmur by partially constricting the vessel.

To be sure, inorganic systolic murmurs are most frequently seen in this area. Nevertheless, it must not be forgotten that organic murmurs also occur here. The organic murmurs are

usually loud, harsh, and rather widely transmitted. They are produced by congenital defects, such as pulmonary stenosis, patent ductus arteriosus, and defective interventricular septum. In these two latter conditions continuous murmurs may occur.

Occasionally, in a perfectly healthy person, a systolic murmur is accidentally discovered during a routine examination. The murmur may be heard in either the erect or the recumbent posture, or in both. The transverse diameter of the heart is within normal limits and the heart responds normally after exercise. The blood-pressure is normal. Sinus arhythmia may be elicited. In other words, our only abnormal finding is a murmur. There are no characteristics which would indicate that it is organic, and, frequently, there is not even a history of any acute infectious process within the knowledge of the individual. Clearly, it cannot be functional; for then we would have some cardiac impairment and probably other signs. As we have previously stated, we do not feel that it can be classed as a physiologic condition. We are unable even to guess at its cause, and, from histories of similar cases which have come to autopsy, no valvular lesion would be found. In some cases reported an aberrant fiber across the ventricle has been found; in others absolutely nothing in the shape of an anatomic defect has been present. Until we learn more of the possible causes for such murmurs we believe that such casual murmurs will result in less confusion if classed as *accidental*. In this way a word which has already been admitted to cardiac nomenclature will be used to designate a purely accidental finding. Of course, it matters not what name is used so long as the name is understood; but it would seem that less confusion will result if this term be employed.

Of the 13,896 men examined by our boards, approximately $1\frac{1}{2}$ per cent. were rejected during the routine examination at their entrance into the service. For the greater part these rejections were for mitral stenosis. Very few were rejected for mitral insufficiency, although approximately 8 per cent. presented systolic endocardial murmurs of some type. The systolic murmurs were present in the following proportions: aortic

systolic, $\frac{4}{10}$ of 1 per cent.; pulmonary systolic, $4\frac{1}{2}$ per cent.; apical systolic, $3\frac{2}{10}$ per cent.

These men have undergone intensive training for periods ranging from three weeks to nine months, and thus far 4 have been discharged from the service. Three of these men were discharged for mitral stenosis, and the fourth, for chronic myocarditis.

A small percentage of these men, less than $\frac{1}{2}$ of 1 per cent., has been temporarily disabled as the result of the too intensive training which produced the irritable heart of soldiers, or neurocirculatory asthenia, as Lewis prefers to call it. The majority of these men were in clerical work prior to entrance into the service. We are unable at this time to state, even approximately, the percentage of these men which ultimately may be discharged, though we believe it will be very small. At present a few of these men are still in the hospital, some are in the Development Battalion, and the remainder have already been returned to duty.

Before we close this paper it may be well to emphasize certain points which have impressed us. A very considerable percentage of individuals having valvular impairment may lead active lives without even being conscious of such impairment. Cases showing valvular impairment plus myocardial change should be limited in their physical and mental activities and ought to be under constant medical direction—as so strongly urged by Mackenzie.

A careful investigation of the myocardial efficiency should be undertaken in every case presenting a murmur. As pointed out, diastolic murmurs arising at either the aortic or mitral orifice indicate a lesion which will sooner or later affect the myocardium. Systolic murmurs, irrespective of type, on the other hand, do not demand limitation of the individual's mode of life unless accompanied by symptoms of myocardial embarrassment. We may be too optimistic concerning cases presenting murmurs. Yet when we consider that such cases which we have observed for months, during intensive training, have not only held up but have improved under it, we feel that we are justified in our optimism.

THE PREVENTION OF THE COMMUNICABLE RESPIRATORY DISEASES

By Major Charles Spencer Williamson, M. C., U. S. A.

Camp Greenleaf, Ga.

In taking up this subject from the army standpoint I am doing so chiefly because I believe it may offer to men not in the service a somewhat different viewpoint from that which they entertain in civilian life. In the latter the physician treats the cases which come to him; in the service he not only does this, which is, of course, important, but he does something else which is vastly more important, *i. e.*, he *concerns himself primarily with the prevention of disease*. Had I been discussing this subject at the time of the Spanish-American War I should unquestionably have taken for my theme the subject of the communicable intestinal diseases, because at that time this group of maladies was chiefly concerned in both the morbidity and mortality statistics. Since that time, as every officer who has spent even a few months in the service knows, these diseases have diminished so rapidly in importance that today they occupy an entirely secondary position. Unfortunately, we have another group of diseases which have in a sense taken their place, and now are easily the most important factor in producing the sick rate in our cantonments. I refer, of course, to the communicable respiratory diseases, and I include under these all diseases which are presumably communicated from one individual to the other by means of the respiratory tract. Under this caption we may rank measles, scarlet fever, tonsillitis, meningitis, diphtheria, influenza, mumps, whooping-cough, bronchitis, and, of course, pneumonia. It would be superfluous, of course, to mention the ordinary infectious colds, since these are so well known to everyone.

With the army and things pertaining to the army uppermost in everyone's mind it will be unnecessary to refer to the statistics of our cantonments during last winter. It is only too fresh in everyone's mind how measles swept through the cantonments, leaving in its wake bronchopneumonia of great severity, and how ordinary lobar pneumonia was of almost unprecedented severity, as well as all sorts of complications, notably empyemas and pericarditis, and others too numerous to mention. At the date of writing (October 1st) "influenza" is already wreaking havoc in some of the cantonments and has gained a foothold in others. It matters very little, in one sense, whether this is the true influenza produced by the bacillus of Pfeiffer or whether it be a pneumococcus and streptococcus infection. From the standpoint of prevention the measures to be taken are substantially the same, leaving out of consideration any possible specific treatment which may be found useful.

I will offer no apologies whatever for taking as my subject, then, the prevention of the communicable respiratory diseases, as this applies to a cantonment such as the one at which I am now serving, *i. e.*, Camp Greenleaf. In a general sort of a way Camp Greenleaf presents identical problems with the other cantonments, in that it represents a large cantonment, roughly of 30,000 men. It presents a more difficult problem than some others in that these men, all belonging to the Medical Corps, come and go with great rapidity. They come in fresh from civilian life, are provided with clothes, taught the rudimentary points of "soldiering" in one division of the camp known as the detention camp, because here they are detained only during the period of incubation of the commoner diseases—*i. e.*, approximately two weeks—and from here they are sent to other parts of the camp through the medium of what is known as the replacement group, from which they are sent to make up the personnel of field hospitals, ambulance companies, evacuation hospitals, base hospitals, hospital trains, etc. In other words, the first two weeks of their stay in camp they are simply divided up arbitrarily, and during this time they are given their prophylactic inoculations, are vaccinated, but are not formed into

permanent units. Company 1 in the detention camp may be ultimately divided into a number of parts, a few men going to one organization, a few to another. Camp Greenleaf consists at the present time of five different groups in addition to General Hospital No. 14, which forms the sixth.

To give any sort of idea of the difficulties of the task which I am discussing it is necessary to say a few words about the housing conditions. In Section "A" we have the medical officers quartered in barracks, some especially constructed for them, others taken over from the Eleventh Cavalry, which is still in part in the park. The detention camp where the men first arrive consists partly of tents and partly of horse-sheds which have been converted into sleeping quarters for the men. These sheds consist of long, low structures with a central partition, the individual stalls having no partitions, but merely a bar between each group of two animals, so that we have two rows of animals facing each other with a partition between them. When these sheds were converted into quarters nothing further was done to them but knock out the feed-boxes and knock down the flimsy bars indicating the double stalls. The tents are the ordinary pyramidal tents in common use. In other sections of the camp the men are housed to a considerable extent in barracks, but a great many in tents.

Now let us try to state the conditions of the problem clearly. A large number of men are suddenly sent into the camp, perhaps 6000 or 7000 in a week. These men arrive in contingents sent by a certain draft board and arrive at Lytle, several miles away, at any time of the day. Here they are met by officers who check up their number, march them to the camp, where they are taken at once to the detention camp proper. Here they receive their clothing and obtain their first insight into army life. The next day their baggage is shipped home and the civilian of yesterday is today a full-fledged soldier, but hopelessly green in every respect. These men bring in with them, as a matter of course, a considerable amount of disease. It is impossible to find 6000 or 8000 men anywhere without some one of them being in the incubation period of some infection.

Now that is just exactly what happens with the arrival of these men in camp. A number are, at the time of their arrival, already infected with the causative organism of some infection or other which will break out shortly after their arrival in camp. Inasmuch as the majority of the commoner communicable diseases would show within fourteen or fifteen days, the period of detention is set at this, and when this period is passed the new recruit is ready to be sent to another portion of the camp to join a definite organization. The problem now is to take this great throng of men, coming from any number of different states, to induct them into a life entirely new to them, to put the men on a diet entirely strange to them, to separate them from home and friends, to teach them drill and the various other things which a soldier must know, and still to maintain them in good health. The point which I have tried to make clear to you in this very brief sketch of a cantonment is that handling these diseases in a well-ordered home or in a well-appointed hospital, especially one with especial wards for contagious diseases, is one thing, and handling these cases in tents, barracks, and converted horse-sheds is quite another, and a vastly more difficult situation. Now remember, if you please, that the army is primarily concerned with the prevention of disease. A well soldier is an effective; a sick soldier may or may not be, later on, an effective. This is, of course, reflected in the weekly reports issued from the Surgeon General's office showing the disease incidence and the rate of non-effectives.

With these preliminary remarks, let us take up in general the diseases already referred to as the communicable respiratory diseases, and let us discuss the measures which are being taken for their prevention to see whether these are adequate and what we may expect of them. Are we likely to see in the immediate future a reduction in the incidence and mortality rate of these diseases comparable with that which has occurred in the communicable intestinal diseases? Let us ask ourselves how these diseases are spread. So far as our present knowledge is concerned, they are spread by the transmission of the infective secretions from the air-passages of an infected individual, and we may

distinguish both direct and indirect infection. Chief among the sources of direct infection is the so-called "droplet infection." It is not necessary here to recount the many researches which have been made along this line, especially in connection with tuberculosis, but the general proposition may be succinctly stated by saying that in talking, coughing, singing, and sneezing droplets carrying the infective organism are transmitted directly from one person to another. In my lectures on this subject I am accustomed to call attention to the importance of immediate proximity as bringing about infection by a comparison with a law governing the intensity of light. If a given candle or other source of light covers an area of 1 foot on a screen 1 foot removed, it covers 4 square feet of this screen at a distance of 2 feet; 9, at a distance of 3 feet; 25, at a distance of 5 feet. In other words, the intensity of light varies inversely proportional to the square of the distance. In a rough way this is true of the liability to infection from droplets. A given number of droplets projected in more or less straight lines in coughing or sneezing radiate as the rays of light do, so that an individual at a distance of 5 feet will receive on a given area only one-twenty-fifth of the number which he would receive at the distance of 1 foot. I know of no more striking way of emphasizing the importance of crowding, whether this be in barracks, in mess halls, in places of public assembly, or what not. To make sure that the authorized number of men in the barracks is not exceeded, the number is plainly stenciled on the outside of the building, and this number must not be exceeded. In the army I should rank overcrowding as possibly the most important single factor in the transmission of this disease. Now we must reflect that overcrowding in the army is likely to be a matter of much more common occurrence than in civil life, for the reason that the exigencies of warfare do not always admit of having hygienic conditions all that they should be.

Indirect transmission is, of course, nothing more or less than the transmission of these same droplets from the sick man to his well neighbor in an indirect manner. When one stops to think of the very many ways in which this can be

brought about, one marvels not that the cases spread at times with great rapidity, but that any individuals remain uninfected. A man blows his nose on a handkerchief, perhaps many times in a day, and almost inevitably soils his fingers in so doing. It does not occur to him that when he shakes hands with another individual he may pass on the organism of this disease to his friend, who, in turn, handles something which goes to his mouth and gets the organism into his system. If the individual is a cook, handling articles of food, the same transmission may occur. Whether or not clothes, etc., may carry the organisms of these diseases is a debated question. It seems to me that we must occupy a conservative position, somewhere between the Scylla of believing that fomites are an important factor, on the one hand, and the Charybdis of believing that they are of no importance on the other. Where men are herded together in close proximity, all coughing unrestrictedly, it might very well be that their clothes become more or less contaminated with the droplets and that these, in turn, serve as a mode of conveyance when the droplets have dried. That this is a factor of very great importance, especially with a short-lived organism as the Pfeiffer bacillus, may well be doubted. The transmission of scarlet fever and the streptococcal infections by means of milk is, of course, familiar to you all, but this plays a relatively unimportant rôle in the army, because of the wide use of condensed milk.

Unfortunately, until we know the precise nature of the organism causing, for example, measles, until we know its cultural peculiarities, we can only speak of measles by analogy. In the case of influenza we know that the organism is relatively short lived and that the disease has a very high degree of infectivity, the Pfeiffer organism being constantly present in the respiratory passages in the true cases. It may well be, because of the difficulty of growing it, that it is not always obtained in cultures, even when it is present in large numbers. This short summary embraces, unfortunately, nearly all that we know on the subject of the exciting causes of these diseases. We come now to the discussion of the carrier, a subject about which a considerable controversy is being indulged in. At the

present writing many men emphasize the importance of the carrier; a considerable number are skeptical as to its importance. It seems to me that until the causative agents of all these infections are very thoroughly known, we are not justified in omitting any precaution looking toward the elimination of the carrier. Now with these facts in our mind, let us take up the measures which may be taken and which are being taken in this camp to prevent their spread.

To begin with, an isolation camp should be established, *preferably in tents*. At Camp Greenleaf we have one for each section of the camp because of the extreme difficulty in obtaining a site for a single camp large enough to take care of the cases from all sections. These camps are of sufficient size to admit of an expansion to a maximum of 8 per cent. of the command of that section. Each camp is under a commissioned officer, and every suspected case of acute respiratory disease except meningitis and pneumonia is sent to these camps, unless, in the opinion of the Camp Surgeon, their condition, when first seen, is of sufficient gravity to warrant direct transfer to the hospital. In a case of meningitis or diphtheria, cultures are *made as soon as possible in every case* admitted to the isolation camp. A most important matter relates to what cases are to be sent to these camps. In meningitis and diphtheria the entire company or organization is promptly quarantined in this camp until the carriers are found and removed, which means that the organization is quarantined until the result of the cultures is had from the laboratory, *but no longer*. To a civilian physician an isolation camp of this sort is a decided novelty. Picture to yourself rows of pyramidal tents, with a guard thrown around them, divided up into sections, when necessary, for the different diseases, the men eating out-doors, for the most part, or in their own tents. They are allowed to mingle out-of-doors, that is, they may take a short walk together or stand around out-of-doors or even do light work to a certain extent, but mingling indoors, especially visiting from bunk to bunk, sitting around on each other's bed, is strictly prohibited. In the conduct of such a camp it is highly important to bear in mind that

certain predisposing factors are important in assisting the organisms of the disease to take hold. We refer particularly to fatigue, wet feet, insufficient nourishment or clothing, and similar factors. Every precaution is taken to give the men a moderate amount of exercise, never carrying this to the point of fatigue. Every effort is made to have them warmly covered at night, to see that they have a sufficiency of good warm clothes and to avoid wet feet, the latter of which, especially in the winter time in the South, is no simple matter. Now, it is to be emphasized that this isolation camp is a very different affair from the civilians' idea of a quarantine camp. For example, if, in a company barracks containing, let us say, 150 men, a case of measles breaks out, we send that case of measles to the hospital; or if it is only a suspicious case, to the isolation camp, but we do nothing in the way of a quarantine with the rest of the company, except that we may isolate a man or even two men on each side of the measles patient. The propriety of this isolation of contacts is doubtful, and while we are doing it in some cases, it is questionable whether it will be kept up. The only diseases for which we quarantine are, therefore, meningitis and diphtheria, and these only for the few days which must elapse before the laboratory reports can be had in the cultures, which enables us then to return the carriers and send the rest of the company back to duty.

The next most important point consists in doing everything possible to prevent indiscriminate coughing, especially where men are congregated in large numbers. This is a matter, of course, of great difficulty. Foreseeing these conditions, a general order (G. O. 84) was issued on September 24, 1918, from which I shall freely quote, since it represents in a nutshell much of our knowledge in this matter. One provision of this order is "particular attention will be paid to the prevention of promiscuous coughing and sneezing, much of which can be controlled. Indoors, coughing and sneezing must be done only with the handkerchief held over the mouth and nose to prevent spreading of infectious material. Offenders in this respect will be disciplined." Personally I have felt, as undoubtedly many others

do, that there is scarcely any point in which the ordinary decencies of life are so frequently outraged as in this respect. People cough indiscriminately, and while the public at large has a vague idea that the consumptive should not be allowed to cough without protecting his neighbors, it has practically no sort of idea that when indiscriminate coughing is indulged in it is a swift and sure means of spreading each and every one of these respiratory infections. Taking then the paragraph in the General Order which I have just quoted, let me impress upon you that there is one thing which we can do and which we do not do, and that is to put an end to indiscriminate coughing. One distinguished surgeon in this camp enforces the rule in his wards by making every one, officer or enlisted man, who is detected coughing without protection of mouth and nose by a handkerchief wear a gauze mask for the rest of that day.

It is clear that if the droplets are received in a handkerchief and the infectious secretions from the nose are similarly received the handkerchief becomes a highly potent source for the transmission of infection. Recognizing this, the same general order goes on, "handkerchiefs used by persons with acute respiratory disease are highly contaminated and may be dangerous as agents in the spread of disease. Outdoor laundries used by the men will be provided with galvanized iron cans suitably mounted on brick work, filled with boiling soapy water and under which fire will be maintained between daylight and dark. All handkerchiefs washed in outdoor laundries will be boiled therein for five minutes before washing. The Sanitary Officer will insure that all clothing washed outside the reservation by private parties is sterilized by boiling." (All laundries in this camp and all washerwomen have been inspected from time to time and a card-index of those found satisfactory—*i. e.*, those who boil the clothing properly—is kept constantly up to date.)

The individual cooking outfits of the men are treated likewise. "All individual mess-kits will be washed by their owners in three separate waters, each of which will be boiling at the time of use. All knives, forks, spoons, and cups in public or

private messes will, after washing, be immersed in boiling water. Drinking glasses will similarly be placed in cold water, which is then to be raised to boiling. Organization commanders will give their personal attention to the enforcement of this requirement." The use of the common drinking-cup, it is hardly necessary to say, is strictly prohibited.

One of the greatest problems which confronts us in the handling of these diseases is what to do with the Y. M. C. A. buildings, hostess-houses, K. of C. buildings, and other places of public assembly. These places are virtually clubs for the enlisted men, and the morale of the camps is immeasurably higher since these agencies have been at work than it was before they existed. They offer places where there is good light, good entertainment, and good company, and without a great detriment to the morale of the camp they could not be closed. We are handling the situation as follows: The windows are kept open, *wide open, all the time*, and efforts are being made to secure increased heating facilities so that this may be possible with the advent of cold weather. It will hardly be possible in the event of high winds and zero weather to carry this out literally, but the effort is being made to make them practically so well ventilated as to *approximate outdoor conditions*. The restriction as to coughing is, of course, rigidly adhered to. The importance of dust in the causation of these diseases, especially pneumonia, has been emphasized by many writers. It was the consensus of opinion that its rôle is a very definite one, although it is not at all certain that the actual organisms are necessarily carried by it, at least out-of-doors. Here it probably acts as a predisposing factor only, preparing the way for the causative organism by producing mild inflammatory changes. Indoors, especially where ventilation is deficient and the sun has little access to the room, it seems probable that the organism itself may be thus transmitted. Recognizing that dust plays a certain rôle, even though this be a subsidiary one, no dry sweeping is permitted, all floors being swept daily with damp saw-dust, and are then mopped with a suitable disinfectant solution. In addition to this, all floors which are, of

course, of wood, are thoroughly oiled with a mixture of crude oil and kerosene to prevent dust. We have even gone farther, and where, under compulsion of military demands for increased accommodations, it has been necessary to use stables and sheds with earthen floors, these have been oiled in a similar manner to keep down the dust.

An exceedingly important point and one which, alas, is but little heeded in civilian life is not to overheat the dwellings. The temperature of the barracks is not to exceed 65° F. I have believed and taught for many years that the sudden changes of temperature to which people are subjected in going from overheated rooms directly out-of-doors is a predisposing cause of some importance. In addition, the hot dry air, drying up the nasal secretions, must reduce the tone and resisting power of that mucous membrane in a very marked degree.

Hand in hand with this ventilation during the daytime goes the ventilation of the sleeping quarters. This is accomplished in the following manner: "Alternate windows on both sides will be kept open each night in all barracks after taps, except that on stormy nights all windows open on the side opposite the wind and the windward side will be closed. All tents will have their door flaps tied back to their full extent at night." During the day ventilation is adequately provided for by requiring all doors and windows of barracks to be kept open during drill periods and during the meal hour. In the case of tents, all these are furled or struck frequently, weather permitting, and they too have their walls looped up during the drill hours in fair weather, and it is forbidden to close any of the ventilating openings except to keep out rain. In other words, every precaution is taken and rigorously enforced to see that the most thorough-going ventilation, in a way utterly unknown in civilian life, is brought about. As a further precaution: Officers and men in tents or barracks will sleep alternately head and foot to diminish transmission of infection through coughing and sneezing.

Recognizing the possibility of transmission of infection by fomites, it is required that "all bedding and clothing will be sunned and aired in the open air for at least two hours, three

times weekly, weather permitting. It will be spread out or exposed on lines, tent frames, or cots, as much as possible to get the full effects of sun and air."

One measure is carried out religiously in the service which is unknown in civilian practice, *i. e.*, careful daily or twice daily inspections. During the period of time which the men pass in the detention camp, that is, during their first fourteen days in camp, a careful examination is made of them, stripped to the waist, morning and evening, paying especial attention to the eyes, nose, and oral passages, and, of course, to the skin, with a view to detecting any eruptive diseases. If the man seems sick or if his pulse be rapid, the temperature is taken, and if found to be over 101° F. he is promptly isolated. This means that a man showing a temperature of 101° F. is presumed to have some infection, even though there is no other objective evidence of it, and he is therefore isolated on the presumption that this infection may be of a communicable nature. Now it should be carefully noted that these cases are not singled out to go to the hospital at once, and this for two reasons: A great many of these cases turn out to be merely "common colds" and similar relatively trifling maladies which can be handled just as satisfactorily in the isolation tent camp as anywhere else. The second reason is that it prevents transferring the soldier out of his organization into the General Hospital and overrunning this with cases not sick enough to imperatively demand hospital treatment.

The management of a quarantine tent camp requires a considerable degree of resourcefulness and particularly good judgment. To begin with, as soon as it attains any size, it must be administered in zones. That is, meningitis contacts and carriers may be in one zone, the diphtheria in another, measles in another, etc. I cannot lay too much stress upon the importance of detecting these respiratory conditions at the earliest possible moment, since it is just in this condition that they attain a very high degree of infectivity. The detection of the cases early and their prompt isolation are the two keynotes of successful management. This applies particularly to the mild cases, since they are especially likely to be overlooked and to go about spreading infection in their path.

To sum up the matter, we may say that the prevention of communicable respiratory diseases is as yet in its infancy. They are spread by overcrowding and constitute the typical "crowd" diseases. All the various means of spreading the infectious material from the nose and throat are operative in their spread. Promiscuous coughing and sneezing, dry sweeping, which raises clouds of infectious dust, sitting around on beds, the clothing, which may have been contaminated by infectious nasal secretion, are all prime factors. The predisposing factors are much the same as for any other disease, particularly fatigue, great mental depression, insufficient food, and chilling of the body by wetting may all be mentioned. Particular emphasis should be laid on dust, since, even if it be not itself the carrier of the disease germs, it acts as an irritant in a very definite fashion. This may, perhaps, seem strange to the doctor of a well-ordered municipality where dust is scarce, but to anyone who has seen the dust storms of the West and South this fact needs no urging.

Our preventive armamentarium consists of fresh air at all times and in all places in maximum quantities with, of course, adequate clothing. The maximum amount of outdoor life in the sunshine should be insisted on. The early detection and removal of suspicious or slightly infectious cases to a properly administered isolation camp, the systematic and careful culturing of appropriate cases, the disinfection of the handkerchiefs, mess-kits, and other eating utensils, allowing mingling freely out-of-doors, but none indoors, are matters of great importance.

Lastly, there is one thing which everyone of my readers may learn from the army, and that is, how much can be accomplished by *simple measures provided these be efficiently carried out.* In an organization where the discipline is good and the measures just mentioned can be enforced under penalties of discipline, even the simple means just enumerated should go far toward keeping down the incidence of this type of disease, even when it is so contagious as measles or influenza. In other words, a few simple measures efficiently carried out are more likely to prove of value than elaborate quarantine and other measures carried out in a half-hearted and slip-shod manner.

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CLINIC OF DR. ALFRED STENGEL

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THE INFLUENZA EPIDEMICS OF 1889 AND 1918

You have had the opportunity of seeing much of the present influenza epidemic in our own wards as well as in the various emergency hospitals to which you have been assigned for duty by reason of the general lack of physicians in this community. You therefore know something of the disease as it presents itself at the bedside, and will perhaps be interested to hear from me some account of the epidemic of 1889–90, which occurred when I was a hospital intern, and of the return waves of '90–'91 and '91–'92. A number of additional circumstances have fixed my attention on the disease, so that the intervening thirty years have not eradicated the impressions made upon my mind by the experiences of those early years. It so happened that one of the last medical lectures I heard before my graduation was on influenza, and the lecturer remarked in a somewhat jocular way that he could wish us no better luck than the occurrence of an influenza epidemic soon after our beginning of active practice because it was likely to be wide-spread, all the patients would feel ill and like-to-die, but all would recover, to our great credit. This teaching was based upon many recorded reports of ancient outbreaks; so commonly had the reputation of extreme mildness been given the disease that names like "the delight" were applied to it. The distinguished Benjamin Rush, our first Professor of Medicine, speaking of the epidemic of 1789–90, says that thousands of people suffered in Philadelphia without being confined

to their homes, and remarks that "a perpetual coughing was heard in every street of the city. Buying and selling were rendered tedious by the coughing of the farmer and the citizen who met in the market-place. It even rendered divine service scarcely intelligible in the churches. With few exceptions the malady proved fatal only to old people and to persons weakened by pulmonary complaints, but it carried off several hard drinkers."

This is not the picture of a serious or fatal malady, however wide-spread it might be, and our lecturer, deriving his opinions mainly from the literature and too young himself to have had knowledge of the epidemic of 1848, was quite correct in his teaching. How far, however, the facts differed from the belief was soon brought home to us by the epidemic of the following winter. During the time of its occurrence I was fortunately on duty in the medical wards, and therefore had abundant opportunity for seeing the clinical features of the disease. In addition, I was much engaged in the pathologic department, where we saw many autopsies on fatal cases. I mention these circumstances because of the fact that the hospital records were quite inadequate on account of the number of interns and nurses afflicted by the disease, and that in consequence much of what I have to tell you is based upon my own records and recollection.

In order, however, to give my account additional credibility you must pardon the further personal statement that in 1891 I became associated with Dr. William Pepper, and assisted him in collecting the statistics on which his description of influenza in his "American Text-book of the Theory and Practice of Medicine" was based. This fact possibly more than any other fixed indelibly in my mind the features of the great epidemic of thirty years ago.

I may epitomize my impressions of the main features of the disease in that outbreak as compared with the present one by quoting the words of Hirsch, the great epidemiologist, who said on January 5, 1890: "I am persuaded that the present epidemic differs in no essential particular from those hitherto described.

The great interest which the outbreak of this disease has excited is to be explained simply by the indifference of the great mass of the medical public to everything taught by history. . . .

"Whatever I had to say about influenza I have said in my historico-geographical pathology, and nothing new has presented itself." This somewhat acidulous and opinionated statement is not, after all, far from the truth, as a careful study of the literature will demonstrate.

THE PANDEMIC OF 1889-1890

Some time about the first of December, 1889, we began to hear of a great epidemic that had appeared in western Russia, and especially in St. Petersburg, in November. Subsequently accounts of the earlier occurrence—perhaps as early as June—of a similar disease in Turkestan was obtained, but the western world knew nothing of this till the outbreak in European Russia. The first definite report in Philadelphia (Medical News, December 21, 1889, and Public Ledger, December 21, 1889) referred to the epidemic in St. Petersburg, Moscow, and other Russian cities, and to the appearance of the disease in Paris. The disease was then epidemic also in Berlin, Frankfort, and other German cities, but had not apparently occurred in England. Subsequently those who investigated the matter found probable cases at earlier dates in all these places, and even in this country, where its certain occurrence seemed to have been near the end of December, it was claimed that cases were met with as early as the end of November or the beginning of December. The exact dates of onset have considerable epidemiologic value, but, unfortunately, the difficulty of distinguishing cases of ordinary catarrhal infections from true influenza renders a trustworthy decision as to the character of early cases doubtful. My impression is that the reports of cases in this country prior to the latter part of December are questionable.

The onset of the epidemic in the Philadelphia Hospital was characteristically sudden, and within a few days large numbers of the nurses, attendants, and physicians were attacked. As noted elsewhere then and in the present epidemic, patients in

the hospital were affected in smaller proportion than the personnel of the staffs and the various employees. After a few days, when the disease had become wide-spread throughout the city, cases were admitted from the outside, and at the acme of the epidemic the wards were overfilled and cots were requisitioned to increase our capacity. Many of the later cases admitted to the hospital were pneumonias, and among these the mortality was very high. The appearance of the wards was much the same as that you have recently seen here, but as the epidemic was undoubtedly of milder character and less frequently complicated with pneumonia the excitement and distress in the whole community were far less than in this outbreak. Moreover, the shortage of doctors and nurses in the city, and the undernourishment of the people owing to the necessary food restrictions on account of recent war conditions doubtless increased the public alarm and added to the gravity of the disease. In other essential features it will be found that the two epidemics were identical.

Within a few days over half of our staff of 22 interns were down with fever and the usual symptoms, and an equal proportion of the 100 odd nurses were affected. Apparently the first cases occurred in the nursing staff. Dr. E. P. Davis and Dr. W. S. Vanneman reported (Medical News, January 11, 1890) the clinical features of the disease as they observed it among 40 of our nurses. An interesting fact in their account is that the first case in the hospital occurred in an immigrant who had landed three days before at Castle Garden, New York, from whom the disease was communicated to a convalescent patient in the next bed, who during the day acted as nurses' waiter. The disease spread rapidly among the nurses, and in a short time appeared throughout the entire hospital and its population of 3500 persons. The rapidity of its extension was much the same as had been observed in other places. Thus from Paris came the report that at the Magazin du Louvre among the 2500 to 3000 employees 300 became ill the first day, and two-thirds of the entire number within three or four days. At the Pacific Mills, Lawrence, Mass., among 4242 employees 1699 (40 per cent.) came down with the disease within a few days.

The extent of the epidemic is better shown by subsequent collective investigations made by various governments and individuals than by the ordinary statistics of health boards. It was everywhere reported that the epidemic was a "mild type of malady," and that there was "much discomfort but little fatality," but at the same time the rate of mortality increased enormously in all parts of the world where the disease had made its appearance. Deaths from pneumonia and respiratory diseases generally as well as from all sorts of chronic disease were doubtless due directly to influenza. For example, in Paris, while but 22 deaths were attributed to influenza in one week, there were reported 346 deaths from pneumonia, as against 67 in the same week of the previous year. There were also recorded 131 deaths from acute bronchitis, as against 47, and 138 from bronchopneumonia, as against 27 in 1888. The total number of deaths from respiratory disease was 742, as against 200 in the previous year. This experience in Paris was exactly the same as that in other places in Europe and America. Pepper's statistics included 35,413 cases occurring in the practice of 272 physicians in Philadelphia, but though the general mortality in the city rose to 3044 in January, 1890, when the epidemic was at its height, as against 1488 in December, 1889, only 116 cases were reported as influenza. It is evident that here as everywhere the mortality due to influenza does not appear in the public statistics. Subsequent investigations showed that among all classes of the populations from 40 to 60 per cent. were affected and that the increased death-rate—everywhere doubled or trebled—was due directly to the prevailing epidemic.

The general type of the epidemic was undoubtedly milder than was that of the present outbreak, and the proportion of cases of pneumonia less, but, as I shall show you, the type of the disease and its complications were not at all dissimilar.

The ages of those affected ranged from that of childhood to old age, but it was a notable fact that there was an unusual amount of illness among aged people which was not usually clearly distinguished as influenza, and the death-rate among old people was greatly increased. The major part of the clearly

marked cases of influenza occurred in young adults, but it is altogether probable that the atypical illnesses of the aged were due to the epidemic disease, and for a long time after the outbreak subsided there was an unusual amount of depression of spirits or ill-health among old people.

The nature of the disease had been the subject of considerable discussion and difference of opinion before it reached us on this side of the Atlantic Ocean. The unfamiliarity of clinicians with the disease—owing to the fact that the last preceding epidemic had occurred forty years before—was the principal cause of this uncertainty. Surely none of us who has witnessed either of these great pandemics (1889 or 1918) could be in much doubt if another should occur. In Paris much stress was placed upon the fact that the early cases at least showed practically no evidence of catarrhal infection of the respiratory tract, and on this account some of the leading clinicians believed the disease to be Dengue. Subsequently the respiratory complications and the greater frequency of bronchitis, even in the early stages of the disease, convinced the medical public that the epidemic was really influenza.

Considerable discussion then ensued as to whether the epidemic was an infectious and contagious malady communicated from person to person, or a miasmatic condition attributable to meteorologic and telluric influences. It must be remembered that at this time bacteriology was in its infancy, and nothing was known of the etiology of this disease in particular. It is unnecessary now to recall all of the facts gathered at the time, but it is interesting to observe that in many places the spread of the disease was clearly traceable to contact with affected individuals, and that its incidence was minimal in remote places, such as light-house stations, where contact with people from affected places did not occur. The rapid pandemic distribution of the disease was generally attributed to atmospheric influences rather than to a high grade of infectiousness, though all careful analyses of the chronology of its appearance indicated no more rapid dissemination than could be accounted for by the rate of travel of human beings from place to place.

Onset.—The incidence of the disease was characteristically sudden. Perhaps I can best illustrate this by my personal experience. Early in the epidemic I began my usual ward rounds one day at 9 A. M., feeling entirely well. After examining one or two patients I felt slight pains in my fingers as I began to percuss the next patient, and in a few minutes grew chilly and then feverish. Within a half-hour I was too ill to continue my work and was forced to go to bed. My temperature rapidly rose to 104° F., where it remained for two days, accompanied by generalized myalgic pains. At the end of this time the fever and other symptoms rapidly declined, and except for some continuance of bronchitis my attack was completed. Almost at the same time one of my colleagues and my room-mate (Dr. Milner) was attacked, and rapidly developed purulent pericarditis, to which he succumbed in spite of surgical drainage. Others of the staff of interns were seized in equally abrupt fashion, and at one time fully 14 of our number were abed. None, however, was seriously ill, and only the one mentioned died. Of the nursing staff of 100 odd, probably over one-half were affected, but none died. The active epidemic in the hospital did not set in till most of us were convalescent, and the seriously complicated (pneumonic) cases came in when the epidemic in the community was at its height and toward its decline. The same you have no doubt observed in the present epidemic.

Let me now very briefly describe for you the clinical features of the disease as we saw it in 1889.

The symptoms at the onset were general muscular pains, headache, backache, and prostration, the last not so specially severe in the beginning as it became somewhat later. There was in the beginning of the epidemic a rather striking absence of catarrhal symptoms in the earlier stages of the disease which led the Paris clinicians to regard the disease as dengue. Later cases, however, showed increasing prevalance of a catarrhal type with bronchial and pulmonary complications and sequalæ well marked.

Fever.—The temperature, as a rule, ran quite high in the more acute cases, being from 102° to 105° F., and not infrequently,

especially in the short cases, the decline of fever was a sharp crisis. More often there was a gradual decline of temperature interrupted by recurrences of fever. In many cases after convalescence seemed to be fairly established remissions occurred, and sometimes these continued for a considerable period after the disappearance of all acute symptoms. This was especially so in patients who got out of bed prematurely. There really was no characteristic curve, though the steady rise of temperature followed by three or four days of continued fever, and then a rapid decline to normal, might be regarded as a typical course in acute uncomplicated cases. Cases complicated by pneumonia showed increased fever after the preliminary influenzal period; though many of the most severe pneumonias occurred without marked increase of the temperature.

Fulminant Cases.—A number of highly severe cases occurred, especially toward the end of the epidemic. In some of these the patients were suddenly seized with chills, excessive fever, and marked nervous symptoms, and died within twenty-four or forty-eight hours with symptoms and signs suggestive of extreme pulmonary engorgement and without clear indications of pneumonia; others with equal suddenness developed acute pulmonary edema like some cases seen in the present epidemic.

Pulmonary Symptoms.—In the beginning, as I have stated, bronchial and pulmonary symptoms were not conspicuous. Later these became more marked, and throughout the epidemic respiratory complications were common. The greatest interest attaches to the question of pneumonia. It is manifest on looking over the records here and elsewhere that many of the cases reported as deaths from pneumonia and other respiratory diseases were actually influenza. The figures I have already given sufficiently illustrate this. In my own service at the Philadelphia Hospital there were admitted very many cases identical with those seen in our wards here during the last few weeks. An interesting feature of these cases as compared with the ordinary pneumonia was the greater degree of prostration, the finely diffuse and usually bilateral bronchitis and pulmonary congestion, and the indefiniteness of the pneumonic physical signs in the areas

presumably pneumonic. For example, in a case with impaired resonance and perhaps a fairly well-marked dulness at one base, the other parts of that lung and the opposite lung would show signs of more or less pronounced bronchitis with dubious indications of patches of lobular consolidation. Frequently, these signs were shifting, so that from one examination to another the whole picture seemed to change. In many of the cases the degree of bronchitis, as indicated by cough, amount of expectoration, and the auscultatory signs, fairly overbalanced the evidence of pneumonia. In such cases the continuance of mucoid sputum and more abundant mucopurulent or sometimes blood-streaked expectoration occurred. In a certain number quite bright blood was brought up. In the unfavorable cases the tendency was in the direction of increasing consolidation, and more particularly when acute toward the development of evidences of pulmonary edema.

A large number of cases of this type died at the Philadelphia Hospital, and I had the opportunity of examining many of these at autopsy. We were struck by the fact that the lesions were almost invariably bilateral and often universal, though one or both of the bases might be specially involved. The solidified portion of the lung on cross-section never showed the dry, granular surface of ordinary pneumonia, but the affected areas of the lung were dark red, even purplish red, the surface on section was moist, and on pressure exuded from the bronchioles a bloody exudate, or in later stages a more or less purulent fluid. The consolidation was rarely complete, and at the same time was not of the mottled type of lobular pneumonia as we were accustomed to see this in the pneumonias of childhood. Among the interns the name "heavy edema" was used because the lung surface exuded a somewhat edematous sanguinolent exudate, and at the same time portions of the tissue sank, when placed in water, in a measure, though not as distinctly, as pieces of the lung in ordinary pneumonia. I had the opportunity of examining the tissue histologically in a considerable number of cases, and found the prevailing features to be enormous engorgement of the blood-vessels, cellular (epithelial and leukocytic) and ery-

throcytic exudation in the alveoli, and infiltration of the alveolar walls. There was little or no fibrinous material in the alveoli, and neither the appearance of ordinary croupous or bronchopneumonia. The outstanding feature was the excessive congestion. There was little pleurisy, but I recall that most of our autopsy material was from cases of very acute character.

Nervous Symptoms.—The preliminary depression and neuralgic pains, delirium and other cerebral disorders, and psychoses and peripheral neuritis as sequels were, I think, more common in the epidemic of 1889 as we saw it than in the one that has just passed over. During the acute stage I remember that at the Philadelphia Hospital we had a considerable number of patients more or less maniacal or psychically depressed, so that they had to be transferred to the detention ward. And after the epidemic subsided it seems to me that we saw more instances of paralysis from peripheral neuritis and general nervous depression than have thus far manifested themselves as the result of the present outbreak.

I remember one intersting instance apparently of peripheral neuritis with paralysis beginning in the legs, afterward involving the arms, in which subsequently cerebral symptoms developed and the patient eventually succumbed, with a general picture not unlike that described as Landry's paralysis. Curiously enough, a not dissimilar case with the reverse order has occurred among my patients in the present outbreak. In this instance cerebral disturbances were followed by paralysis of arms and legs evidently due to peripheral neuritis. The cerebral symptoms have cleared up, and the patient is now very gradually improving from the peripheral symptoms.

Circulatory System.—I do not recall that anything especially impressed us during the epidemic in so far as the heart and circulatory apparatus were concerned, but, on referring to the literature, I find in the article by Davis and Vanneman, already quoted, that they make note of the fact that the temperature was often 104° F., the pulse rarely exceeding 100. You will see that this corresponds with our experience in the present epidemic. While circulatory depression was not pronounced in the course

of the disease, cardiovascular sequels were particularly frequent, and I recall especially the publications of Sansom, then the leading authority in England, on cardiac sequelæ. He described various forms of cardiac arhythmia, bradycardia, tachycardia, and the like as consequences of influenza. It is too early at present to predict whether the result of the present outbreak will be similarly marked in the direction of circulatory derangements. It is early enough, however, to state that in the epidemic of 1889 far more cardiac depression resulted from the disease than in the present one, the reason for this being doubtless that at that time older people were to a much greater extent and, perhaps I may say, to a preponderating extent affected.

Physical Signs.—In the beginning very few evidences of bronchial or pulmonary disease could be detected in a large number of the cases, as I have already mentioned. In later cases at the onset of the disease the evidences of bronchitis were found, and in the severer cases these were followed by signs of pulmonary engorgement manifested by soft crackling râles and some impairment in the percussion note. Frequently the râles were of a quality that could be best described as "sticky." The breath sounds became increasingly altered, but variable from time to time, and shifting in such a way that it was difficult to determine what the exact pathologic conditions might be. Almost invariably, however, in the most serious cases there developed at the bases of the lungs posteriorly denser and denser consolidation, though not often the complete dulness of an ordinary pneumonia, and throughout the disease the râles persisted. Whether the consolidated and presumably pneumonic portion of the lungs was at one place or another, it was customary to find diffuse signs on both sides of the chest, and shifting pictures of either temporary atelectasis or engorgement, with subsequent relief.

In the most acute of all the cases rapid pulmonary edema developed and, as I have noted before, some patients died before there were any distinct evidences of pneumonia.

Signs of pleurisy and of pleural effusions were not so commonly encountered as in ordinary pneumonia or as we have

seen in the latter part of the present epidemic. I think it but fair to say that our training in methodical physical examination was not as well developed at that time, that we were less prompt to resort to diagnostic needling and, of course, the *x*-ray was then unknown. For these reasons I surmise that we overlooked many cases of moderate effusions that might be recognized at the present time.

Gastro-intestinal Symptoms.—At the onset of the disease nausea, vomiting, and other gastric disturbances were encountered in a certain number of cases, and it was clearly seen that a certain minor proportion of the cases could properly be classified as belonging to a gastro-intestinal variety. In these, disturbances of the stomach, abdominal pains, and diarrhea were among the symptoms, and in some of them these evidences of digestive disorder were pronounced.

Menstrual Disorders.—I do not recall from my own experience that menstrual disorders were particularly noted in the epidemic, but I am interested to find in the report of Davis and Vanneman, which was based particularly upon their observations among the affected nurses at the Philadelphia Hospital, that precipitated menstruation was almost habitual. Although they also discuss some cases occurring in the maternity wards, they do not mention premature labor or abortion. Reference, however, to the older literature reveals the fact that for a long time it had been recognized that influenza tends to bring about these results in pregnant women. Curiously enough, this fact had been little recognized prior to 1889, and had been again forgotten between that time and the present epidemic.

Complications.—Among the complications, in addition to the nervous symptoms I have already mentioned, there were a certain number of cases with suggestions of meningitis or actual meningitis, though we did not at that time practice the method of lumbar puncture, later introduced, which might have enabled us to diagnose the condition more certainly.

The most frequent and outstanding complications were those affecting the lungs and pleura. I have indicated sufficiently the frequency of pneumonia. Pleural effusions and

empyema occurred in a relatively small proportion of cases, but persistent consolidations of the lung and long-continued bronchial troubles were met with as sequels very frequently.

Cardiac and cardiovascular complications and sequels were not at all infrequent. During the height of the epidemic pericarditis now and then developed.

Renal complications were apparently infrequent. I cannot give any figures as to the frequency of albuminuria and cylindruria, but it is quite certain that very few cases of actual nephritis developed.

Among the sequels of the disease, persistent asthenia, lack of vitality and resistance, a general depression of the nervous system, and a tendency to coldness and inability to bear lowering of temperature were very marked. This also I believe may have been more conspicuous in the earlier epidemic than in the present on account of the larger number of people of advanced years affected in the outbreak. I recall particularly cases in which for months and even for years after the attack patients were in a reduced state of vitality that made them susceptible to every change of temperature, and forced many of them, fortunate enough to be able to do so, to seek warm climates with the beginning of cold weather.

The Bacteriology of Influenza.—At the time of its outbreak in 1889 nothing whatever was known regarding a possible specific organism, and not until 1892 was any light cast upon this subject. Pfeiffer, however, succeeded in isolating a Gram-negative bacillus of very small size which in its staining peculiarities suggested a diplococcus, and later this organism was accepted by most authorities as probably the specific cause of the disease. After the subsidence of the great pandemic and the return epidemics of 1890 and 1891 the influenza bacillus was commonly found by bacteriologists in endemic cases, and it seems certain that it had never wholly disappeared before the outbreak of the recent recurrence. I shall refer to it again after speaking of the present epidemic.

THE SECONDARY EPIDEMICS OF 1890-91 AND OF 1891-92, AND THE PSEUDO-INFLUENZA OF SUBSEQUENT YEARS

Like a number of the great pandemics recorded by medical historians, the epidemic of 1889–90 was followed by return waves during the two following winters. In this respect it resembled especially the epidemics of 1729–30, 1788, 1830, and 1848, all of which were followed by secondary outbreaks. The return epidemics of 1890–91 and 1891 and 1892 were in some places, as in Great Britain, more extensive and severe than the first, and in practically every part of the world where the disease appeared during the original outbreak some degree of recurrence was observed. Even before these definite recurrences of the two following winters there had been in some places minor return waves of the disease during the spring and fall of 1890. After 1892 repeated fall and winter epidemics of catarrhal infections occurred, and these were at first reported as influenza and later were more generally spoken of as grip—no doubt with the subconscious thought that though the name la grippe was originally used as synonymous with influenza, the English equivalent did not altogether commit the reporter to the diagnosis of true influenza. Taken individually, cases in these so-called "grip epidemics" could not be distinguished from the milder cases of true influenza observed in the great epidemic, but taken as a whole the recurring winter epidemics did not impress those of us who had seen the great pandemic as being the same disease. After Pfeiffer's bacillus was discovered bacteriologic studies of these minor epidemics repeatedly showed abundance of streptococci, pneumococci, or Micrococcus catarrhalis, but only exceptionally the influenza bacillus, and names like "pseudo-influenza" or "influenza nostras" were suggested for these influenza-like outbreaks. It is perhaps unnecessary for me to detail the clinical differences, but, in brief, I think it worth while to direct your attention to some of the main facts. The pseudo-influenza cases, as a rule, show a greater tendency to produce catarrhal affections of the nose and throat (coryza, sinusitis, tonsillitis, membranous deposits in the throat, and uncomplicated bronchitis); the depression of the patient is far less con-

spicuous, and cyanosis and other toxic manifestations are less evident; leukocytosis is common, gastro-intestinal symptoms and neuritis or other nervous conditions less frequent, while pneumonia is far less common, and when it occurs more distinctly an ordinary pneumococcic complication, with the usual physical signs and clinical features. The mortality of the epidemics as a whole is comparatively negligible. If we include in the group under consideration certain epidemics of streptococcus infection (milk infections) of recent years, and the outbreak of last winter in our cantonments, the last statement regarding mortality would, of course, require modification, but the clinical features would nevertheless distinguish these epidemics from true influenza. For several years past in filing our histories of patients in the University Hospital we have adopted the title pseudo-influenza to designate these cases. Perhaps we may in the future be able to separate them into defined groups, but for the present no better nomenclature seems to offer itself.

Incidentally, I think it of some importance to direct your attention to the fact that the recurring winter epidemics have given physicians as well as laymen the impression that influenza is always a winter disease. Almost the contrary appears to be the case. At all events, a number of the great pandemics of the past, including the present one, began in the early fall or even in late summer, and on account of this misapprehension doubt was expressed regarding the nature of the recent outbreak when it was first reported in Europe.

While the diagnosis of individual cases is uncertain, that of epidemics as a whole ordinarily should not occasion great difficulty. The greatest cause of confusion lies in the fact that after every pandemic outbreak residual cases no doubt act as carriers and occasion endemic recurrences, and even mild epidemics follow.

THE PANDEMIC OF 1918

During the summer of 1918 reports came to us that there had appeared in Spain a wide-spread epidemic of influenza of some-

what virulent character. Later the disease appeared among the Austrian and German armies; still later reports came to us from our own armies and those of our Allies in France. In extent and in the seriousness of the cases the epidemic seemed to equal or surpass that of 1889, and from the rapid pandemic distribution, as well as from the character of the symptoms reported, there was little doubt but that this so-called Spanish influenza was the same disease as the "Russian influenza" of 1889. Not until early or mid-September did the disease reach this country, and its outbreak here was attributed to the arrival at Boston harbor of a ship bearing numbers of sailors ill with the disease.

It may be interesting, however, for me to refer to the fact that we had during the previous month in our wards here a curious epidemic condition among Hindu sailors landed from a British ship arrived in this port from Liverpool. Some 30 Hindus and 1 white man, a petty officer, on board the ship were the patients received by us. All of them had been taken sick five days or more after the ship had left Liverpool, where there was at the time an epidemic of bronchial or pulmonary infection mainly among the seamen. I shall not pause now to point out the differences in the cases of these Hindu sailors from those met with in the influenza epidemic that broke out a month later, but shall merely mention the facts that they all were suffering with unusually violent bronchial catarrh with abundant mucopurulent expectoration, that they developed a form of pneumonia with curiously disseminated patches of consolidation, that the blood-picture was that of a marked infectious leukocytosis, and that none of them showed any evidence of pleural complications. The respiratory rapidity and the marked dyspnea, the rapidity of pulse, the leukocytosis, and in the fatal cases the occurrence of small foci of suppuration in the lung distinguished these cases very sharply from true influenza. Our bacteriologic studies showed cultures of Micrococcus catarrhalis, streptococci, and pneumococci, but no influenza bacilli. I do not, of course, pretend to say that the last organism was not present, for the difficulty of its culture to those who have not previously had experience with the epidemic disease was well recognized; but

the symptoms and pathology of the disease marked it as something different from influenza.

Onset of the Influenza Epidemic.—The epidemic apparently made its appearance in this country at Boston Harbor, whence it rapidly spread to the people of the city, and later to adjoining portions of the State of Massachusetts. Subsequently it appeared in rapid succession in most of the important centers of population in the East. Its appearance in the middle and far West and finally on the Pacific Coast was so timed as to suggest the transportation of the infectious agents by affected individuals.

The first reports of the disease in Philadelphia came from the Naval Station at League Island and the Naval Hospital, and the epidemic became extremely severe in these centers before the community as a whole began to be affected. After an interval of ten days or two weeks it appeared in all parts of the city and rapidly assumed gigantic proportions.

I shall not attempt to detail the symptomatology of the disease, as you have seen it, but wish merely to contrast its features with those of the earlier epidemic which I have described for you, and to allude to some of the striking or peculiar features of the present outbreak.

The onset of the disease was much like that in 1889, although the nervous symptoms seemed to be less marked and the catarrhal symptoms (bronchitis) more pronounced. One striking symptom that occurred in many of the early cases was cyanosis. Sometimes this was of mild degree; at other times profound, despite the fact that circulatory weakness and even marked respiratory embarrassment or extensive bronchial involvement were not present. The cause of this cyanosis has not been clearly determined. There is a disposition to attribute it to changes in the blood itself, to methemoglobinemia, but I cannot say that this is established. Certainly it was not attributable to circulatory causes. In the latter part of the disease when pneumonia entered in as a complication another type of cyanosis frequently presented itself, though perhaps no more commonly than would be the case with ordinary pneumonias.

Cough and catarrhal symptoms were certainly conspicuous from the beginning in the great majority of cases, and in this particular again the disease differed from that of 1889. Abundance of sputum, sometimes merely mucus, more frequently mucopurulent, was usual; but in many cases there was a dark brown (prune juice) expectoration or it was bright red from admixture of blood. Occasionally there was free hemoptysis.

Respirations.—The patients frequently presented little embarrassment of respiration despite excessive fever, and even when pneumonia developed; and sometimes with excessive bilateral pneumonia the absence of respiratory embarrassment was conspicuous. Perhaps the majority of the cases showed no decided increase in the rate of breathing until the pneumonia had reached its latest stages.

Physical Signs.—These were practically identical with those seen in the earlier epidemic, except that they developed more promptly, and were, on the whole, more conspicuous. There was, however, the tendency to diffuse bilateral involvement, with evidence of a distinct localization at one or both bases, or sometimes the apices. The shifting character of the physical signs was much the same, and the long-continued residua of bronchitis, consolidation, and perhaps pleural exudation exactly reproduced conditions as I had seen them before. There were cases in which the probability of bronchopneumonia could scarcely be doubted, though the physical signs gave little evidence. There were others in which the probability of pleural effusion seemed undeniable, though needling and *x*-ray examination failed to detect any exudate, and there were cases in which the shifting character of the signs from day to day left one in complete doubt as to the pathologic lesions present.

Cardiovascular Apparatus.—I have mentioned to you the fact that the relative infrequency of the pulse was noted in the former epidemic, but it certainly was far less striking than in the present, since few writers allude to it. I do not recall that we commented on it particularly at the time. Among our recent cases it has been so marked a feature that one could not well escape observing it, and from the tables I shall show you you

will see how very pronounced this feature was. In not a few of the cases even when extensive pneumonia had developed the pulse-rate remained below 100, 90, or even 80.

During the height of the epidemic but little cardiac arhythmia or other forms of cardiac disturbance were observed. Toward the end of the epidemic, however, some cases of this type made their appearance, and many other conditions—bradycardia, tachycardia, extrasystolic irregularity, and auricular fibrillation—occurred. Mild cardiac pains were not uncommon. Severe anginal attacks were rare. A number of cases of syncope, however, occurred, and in one at least I observed a fatal syncope in a convalescent patient who showed no objective evidence of cardiac disease on careful examination after the first and rather mild syncopal attack.

Gastro-intestinal symptoms were, perhaps, more common during the present epidemic, though cases of the so-called gastro-intestinal type were possibly more rare. A number of cases of vomiting of blood, a few instances of hemorrhagic diarrhea, occasionally excessive and exsanguinating, were met with. Toward the end of the epidemic it seemed to me that gastro-intestinal symptoms became less common.

Renal Manifestations.—Albumin and casts were very commonly found in the urine, and seemed to me of little significance except when they were accompanied by other evidence indicative of a nephritis. A few cases of acute hemorrhagic nephritis with pronounced uremic symptoms were observed in our series.

Nervous Symptoms.—Headache, backache, pains in the extremities, and various forms of neuralgia marked the onset of many cases. Though severe cerebral symptoms were rarely seen in the early stages of uncomplicated cases, I understand that the experience in some of our army camps in France was very different. There, I am told, intense headache and signs of meningeal irritation were not uncommon, and frequently required lumbar puncture for their relief.

In the later stages of the disease, depression, apathy, and loss of muscular power were occasionally found; paralyses occurred in some cases, while peripheral neuritis and local paralysis from

whatever cause occurred only occasionally. The present epidemic is not greatly different from the earlier one so far as the nervous symptoms are concerned, though, on the whole, it has seemed to me these symptoms have been less marked. Among more severe symptoms I have observed stupor and convulsions apparently independent altogether of any renal complication.

Menstrual Functions.—Precipitated or premature menstruation was so habitual a symptom that it was regularly expected by us in all women patients, and you have heard the danger of abortion or miscarriage so frequently emphasized that I need not do more than mention it now. The particularly high mortality of the disease in pregnant women was everywhere commented on.

Special Sense Symptoms.—Disturbances of vision, of hearing, and of the olfactory sense have occurred among a small number of the cases, but seem to have been definitely less frequent than in some of the epidemics of pseudo-influenza of other years. These symptoms referable to the special senses were about as common in the present epidemic as in 1889.

Complications.—I have already mentioned in connection with the special organs complicating conditions that have arisen, and wish now only to refer again to pulmonary conditions. It was very striking that in the early period of the epidemic pleural complications were comparatively rare, while severe pneumonias, often rapidly fatal, and sometimes overwhelming pulmonary infection, with fulminant pulmonary edema, gave the disease its most striking characterization. Later, pleural complications came to be more and more in evidence, partly because some of the pneumonia cases dragged on and the later-occurring influenzal infections apparently were less virulent and allowed time for the development of pleurisy. It was conspicuous, at all events, in our wards toward the end of the epidemic that the mild influenzas had all recovered, that the acute cases of pneumonia had recovered or died, and that we were left with a group of cases of residual unresolved pneumonias, empyemas, and cases of pleural thickening. It is from this group, no doubt, that the large numbers of chronic bronchial and pulmonary sequels of

influenza are recruited. It was a noteworthy fact that after the epidemic of 1889 pulmonary disease seemed to have increased enormously throughout the world, and in the light of our present experience, with our better means of investigating cases by the methods of bacteriology and radiography, it is possible to assert that many cases of supposed tuberculosis of the lungs have undoubtedly been instances of postinfluenzal residua.

Among the lesions present in these cases, in addition to the ones I have already mentioned, bronchiectasis should be remembered. The circumstances are such as to make the development of this condition altogether likely; for, as in the bronchopneumonias of childhood, neighboring bronchial tubes become weakened and dilated, so in the influenzal pneumonias of earlier or later life the same thing takes place. Certain it is that many individuals date chronic bronchial disease (possibly or probably bronchiectasis) from a severe attack of influenzal pneumonia with delayed and incomplete resolution.

Bacteriology.—Studies of the bacteriology of the disease were prosecuted with unusual zeal in various places, and though a final decision cannot be expressed regarding the etiology of the disease, some facts of importance were brought out. A Gram-negative bacillus answering closely to the original description of Pfeiffer was obtained from the sputum of a considerable proportion of the cases studied. In some laboratories it was found in as many as 80 per cent. of all cases studied—elsewhere smaller proportions of positive cultures were reported—a discrepancy that may be accounted for by some of the technical difficulties and by unfamiliarity with the best methods of cultivation. In a high percentage of the cases in which cultures were made from the lungs at autopsy the same organism was recovered; and in a small proportion of cases blood culture was reported as positive. Associated with this organism the sputum and lung cultures showed streptococci, the pneumococcus, Friedländer's bacillus, and occasionally various other organisms. The frequency of occurrence of the so-called influenza bacillus contrasts very strongly with bacteriologic experience in any of the recent epidemics of acute respiratory disease, such as those

of the winter of 1917–18, as well as in previous outbreaks of similar kind, and suggests the possibility of an etiologic relationship of the bacillus to the disease. Moreover, the clinical features of the disease were not such as would correspond with infection by any of the associated organisms named. The possibility of the disease being due to a filterable virus was suggested by some of the features in the epidemiology, but direct investigations gave no support to this assumption. At present, therefore, probability seems to lie in favor of the influenza bacillus as the cause of the epidemic, with other organisms of importance in certain of the cases complicated by pneumonia or other conditions. There is, however, abundant ground for believing that mixed infection is not at all essential to the occurrence of pneumonia.

Cause of Death.—One of our cases represented the type of acute fulminant influenzal death. The patient, one of the pupil nurses, was on duty and apparently well till 7 P. M., when she reported to her head nurse that she felt feverish. Her temperature was 100° F. During the night her fever increased and she presented physical signs of pulmonary congestion. Early in the morning pulmonary edema developed, and at 11 A. M. the patient died, without having developed clear evidences of pneumonia. Excepting in this case physical signs were found in every one of the 52 fatal cases which had led to a diagnosis of pneumonia before the death of the patient. In some of the cases these signs were indefinite and scattered, but in none were we in doubt as to the actual presence of pneumonia.

Some of the statistics of our hospital cases will interest you:

I. *Cases:*

Influenza, uncomplicated	150	
Influenzal pneumonia (56 per cent.)	113	—died, 52 (46 per cent.)
Total	263	— " 52 (20 per cent.)
Cases admitted with pneumonia	84	— " 46 (54 per cent.)
Cases developing pneumonia in hospital	29	— " 6 (20 per cent.)

You will note that a large percentage of our cases were admitted to the hospital with pneumonia, and many of these were practically moribund and lived only a few hours.

II.—*The Ages of the Patients:*

15 to 20	24
21 to 30	105
31 to 40	41
41 to 50	7
51 +	5

The ages were almost exactly the same in the uncomplicated cases and the pneumonic group.

III.—*Symptoms at Onset of Influenza:*

Pains in the head, back, limbs, or abdomen occurred in about 60 per cent. of all the cases.

Gastro-intestinal symptoms—nausea, vomiting, or, more rarely, diarrhea—occurred in 25 per cent.

Cough and mucoid expectoration were present in 75 per cent.

The onset of fever was abrupt in 85 per cent.

Cyanosis was frequent but marked in but a small number. The figures recorded are uncertain.

IV.—*The Pulse-rate:*

In uncomplicated influenza the average rate was 75 to 85 or 90; few cases (6 or 8) 100 to 105.

In pneumonic cases the average pulse-rate throughout the disease was 100 or less in 80 per cent. Toward the end of fatal cases the pulse-rate rose over 100 in less than 50 per cent.

V.—*The Respiration Rate:*

In uncomplicated influenza the highest rate was 31; in practically all the rest it was from 20 to 23.

In the pneumonia group we find the following figures:

Recovered cases,	above 40	1 case	(late)
	above 30	23 cases	(early)
		8 "	(late)
	above 20	28 "	(early)
		37 "	(late)
	below 20	5 "	
Fatal cases,	above 40	13 "	(early)
		18 "	(late)
	above 30	24 "	(early)
		14 "	(late)
	below 30	9 "	

The respiration rate was, therefore, a better indication than the pulse of probable fatality, but was by no means a trustworthy guide.

VI.—*The Temperature:*

In uncomplicated influenzas the highest (average) temperature was from 100° to 102° F. in the great majority of cases. Occasional elevations to 104°, F.

occurred, but an average height of 104° F. was not shown in any of this group.

In the pneumonic group there were—

19	cases	showing	average	104° F.
34	"	"	"	103° F.
23	"	"	"	102° F.
9	"	"	"	101° F.
7	"	"	"	100° F. or less.

VII.—*The Blood-count:*

	Uncomplicated cases.	Pneumonic cases.
15,000 +	3	12
9–15,000	13	21
2– 9,000	38	26

VIII.—*The Urine:*

In uncomplicated influenza albumin and casts were found in 28 cases, and either albumin or casts alone in 14.

In the pneumonia group albumin and casts were reported in 49 cases.

IX.—*Onset of Pneumonia:*

The time of onset was within the week after beginning of influenza in 42; over a week in 17; doubtful in 40. Chills marked the onset in 22; sudden increase of fever in 27 (in 16 of these there was no chill), and by change in physical signs in 18.

X.—*Termination of the Pneumonia in Recovered Cases:*

Decline of fever by lysis in 38.

Decline of fever by crisis in 13.

XI.—*Physical Signs of Pneumonia:*

Definite	75
Indefinite	18
Doubtful	6

The terms "definite," "indefinite," and "doubtful" are here used in the sense of the evidence of distinct areas of consolidation. In the doubtful cases there were auscultatory signs, leaving little question of the presence of pneumonia.

XII.—*Distribution of the Pneumonic Areas:*

Definite:

Lower lobe, Left	21
Right	16
Both	26
Upper lobe, Left	1
Right	0
Whole lung, Left	2
Right	3
Upper lobe and opposite base	6
	75

Indefinite and doubtful:

Right lung	7
Left lung	4
Both lungs	5
Scattered areas	8
	24

XIII.—*Marked Cyanosis:*
- Fatal cases..... 17
- Recovered cases..... 3

XIV.—*Pleurisy:*
- Indicated by physical signs or *x*-ray..... 22
- Confirmed by needling..... 4

In conclusion, let me call your attention to what you probably observed in the course of the epidemic—the variation in the clinical picture of the disease at different periods of the outbreak. In the beginning, short cases recovering quickly or severe ones terminating in rapidly fatal pneumonia without complications were conspicuous. Later the cases were less acute and pleural complications began to become more frequent. Toward the end, as at present, our wards have contained numbers of influenzal and pneumonic residua—pleural thickening, empyema, unresolved pneumonia, etc. In all these particulars the present epidemic does not differ from those of the past; and it is safe to predict that sequels such as neuroses, peripheral neuritis, sinus infections, general asthenia, and cardiac disorders will follow, and return waves of minor epidemics will make their appearance. The number of cases of pulmonary residua with dubious physical signs will make the diagnosis of pulmonary tuberculosis in the absence of discovered bacilli more questionable than before the epidemic made its appearance.

CLINIC OF DR. H. R. M. LANDIS

University Hospital

INFLUENZA AND SOME OF ITS COMPLICATIONS

This morning I wish to discuss with you some of the phases of the present epidemic of influenza as we have seen it in the wards of the University Hospital. So far as I have been able to gather from reading the accounts of past pandemics, the present one differs little from those that have been recorded in the past except that, possibly, the number and the severity of the complications have been greater. While we have had a few instances of the nervous and of the gastro-intestinal type of the disease, the bulk of the cases have belonged to the respiratory type. The severity ranges all the way from the simple, benign influenza of two or three days' duration to those with serious and fatal complications.

The history of the onset as given by the patients is singularly uniform. The attack may develop with malaise and drowsiness, chilly sensations, to be followed by headache, pain in the eyeballs, and pain, often very intense, in the bones, muscles, and small of the back. In addition, in the respiratory form, there is commonly coryza, sore throat, soreness or actual pain in the chest, and cough, which at first is apt to be unproductive and later accompanied with mucopurulent sputum. The sputum, in addition, may be blood-tinged and at times consists of almost pure blood. Gastro-intestinal disturbances are relatively common for a day or two, but only in exceptional instances can they be looked upon as severe enough to consider the case one of the true gastro-intestinal type. Many of the patients complain of nausea and vomiting for the first few days of the attack. While it is said in the previous epidemics that a mild type of the disease is sometimes seen in which there is little or no fever, none of this type

has come under our observation. Fever is nearly always present, and may at the onset be quite high. The temperature chart may show a high continuous type of fever for a few days, or it may

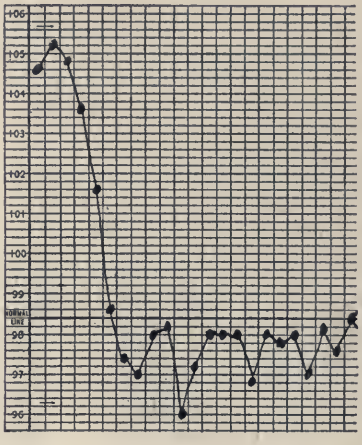

Fig. 127.—Simple influenza. Fever of short duration, with sharp decline.

rapidly fall to normal in the course of thirty-six to forty-eight hours (Fig. 127). More often it gradually falls by lysis (Fig. 128). Often the temperature falls irregularly, and at times the

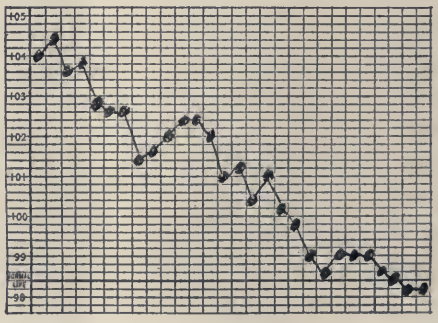

Fig. 128.—Simple influenza. Fever of four days' duration. Gradual decline. A few râles at both bases. No other physical signs.

fever curve may be marked by sharp intermissions (Fig. 129). Not uncommonly when the fever subsides the temperature may

become subnormal and may continue this way for days and often weeks (Fig. 130). During this period a marked slowing of the heart action is common, the pulse-rate dropping to the 50's or 40's. Several of these cases have been studied by means of the

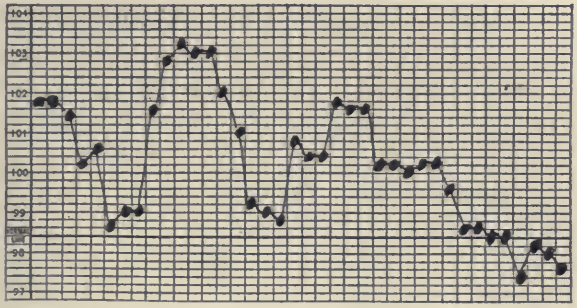

Fig. 129.—Simple influenza. Eight days' duration. Marked congestion of pharynx and tonsils. Gastro-intestinal symptoms for two days. A few scattered râles at bases of lungs.

electrocardiograph, but nothing abnormal was found. The respiratory rate even in uncomplicated cases is subject to marked variations. It may be quite high, but rarely continues so unless there is complicating lobar or bronchopneumonia. In the simple

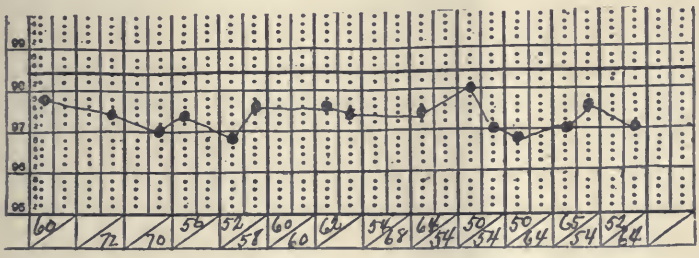

Fig. 130.—Subnormal temperature and low pulse-rate during convalescence from influenza.

uncomplicated case it may range from normal to 30 or 40 times a minute. The explanation is not clear. Graves attributed the high rate to inhibition of the pneumogastric nerve, while Lichtenstern thought it might be due to marked but transient

congestion of the lungs. Possibly it may be an evidence of acidosis. As I have seen these cases I have come to fear a high respiratory rate much more than an unduly rapid pulse or high fever. Patients with a high respiratory rate always seem to be extremely toxic.

Profuse sweating is also noted in many of the cases, and is often marked even in the presence of very high fever.

While a few cases of the milder type will show little or no evidence of bronchitis, the great majority will, on examination, reveal the presence of râles over both lungs. The râles may be distributed fairly evenly on both sides, but in most instances they are most marked and commonly limited to the bases posteriorly. The râles are usually fine and sticky in character, and in many instances the fine, crackling sound close under the ear suggests involvement of the pleura as well. When the involvement of the respiratory tract is limited to involvement of the upper tract and bronchitis, the duration of the attack is from two to six or seven days. The temperature then falls to normal, pain disappears, and the râles have either disappeared or rapidly diminished from day to day. On the other hand, if the chest condition is protracted beyond a week, or even after the fever has disappeared the râles persist, there has probably been some bronchopneumonia. This is almost certainly the case if dyspnea is at all marked and the patient is prostrated. I will speak of bronchopneumonia more in detail later.

In a few instances we have seen what was apparently a relapse of the influenza infection without serious implication of the lung itself. In such cases after a febrile period of three or four days the temperature falls to normal or nearly so. After a few days the temperature again rises for a brief period (Fig. 131). If the second febrile disturbance is prolonged, however, it is more than likely that this secondary rise has been the result of some intercurrent disturbance, either of bronchopneumonia or a small collection of fluid. This has certainly been our experience as a result of *x*-ray examinations of these cases.

Shortly after the last great pandemic of influenza Pfeiffer, in 1892, discovered the influenza bacillus, and ever since that

time this organism has been considered as the exciting cause of the disease. Just at present, however, there is some confusion in the minds of bacteriologists as to whether this organism is the dominant factor. The number of positive findings has varied greatly. In some instances the bacillus has not been recovered in more than 10 or 15 per cent. of cases; in others it has been found in as high as 75 per cent. of cases. Bearing in mind that it is a difficult germ to work with, and that for some years it has not been encountered very frequently, we probably have an explanation as to why it has not been found in many cases. Indeed, several of my bacteriologic friends have admitted that at

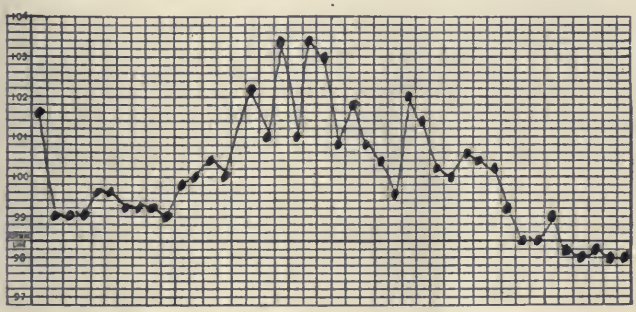

Fig. 131.—Relapse. Patient taken ill two days before admission. Temperature declined to nearly normal, remained so for two days, and again rose. A few râles at right base.

the beginning of the epidemic they had very poor success, but later, when they became more familiar with the bacillus, the percentage of positive findings was high.

Another factor that may have some influence is the almost constant association of other organisms. As has been well said, the influenza bacillus opens the door through which many other micro-organisms enter. These may overgrow and obscure the influenza bacillus, just as from the clinical standpoint the secondary invaders produce lesions which vary greatly from those seen in simple uncomplicated influenza. Among these associated organisms may be mentioned the streptococcus, pneumococcus, staphylococcus, Micrococcus catarrhalis, Friedländer's bacillus,

etc. The streptococci and pneumococci are by far the most important, and to them is to be attributed most of the serious complications.

In the respiratory type of the disease the entire respiratory tract is involved to a greater or less extent. The tonsils, pharynx, larynx, and trachea as far down as can be seen are inflamed. At the autopsy table the bronchial mucous membrane is more or less congested and inflamed and often filled with a sanguinolent, frothy mucus. In addition, the bronchial wall is swollen and softened. It is quite likely that this predisposes the bronchi to dilatation. It has long been recognized that there is a close connection between influenzal infection and bronchiectasis, and that the bacillus of influenza is the one organism most frequently associated with this condition.

In the present epidemic, so far as we have observed it, but relatively few of the cases were of the simple uncomplicated type. The occurrence of bronchopneumonic areas was extremely common. These areas are in some instances small and located in the lower lobes near the hilus, or they may involve very considerable portions of the lower lobes.

Bronchopneumonic areas occurring in influenza often show distinct interstitial changes, and it is quite likely that this accounts for the persistence of these areas of consolidation and their slowness in resolving.

In some cases the lobar involvement is typically of the pneumococcus type. In others the lobar involvement is atypical. It often presents the appearance of being lobular primarily and only gradually becoming lobar. Thus there will be seen lobular areas in various stages.

Influenza pneumonias, whether bronchial or lobar, seem to be complicated by effusion more often than the ordinary types of these affections. The fluid may be free in the pleural cavity or encapsulated. Usually these effusions are purulent, and their presence should always be suspected when the fever is unduly prolonged.

At times in these epidemics a very fulminant type of the disease is encountered in which death occurs early. At the

autopsy the lungs are found to be greatly engorged and at times show the presence of hemorrhages into the pulmonary tissues.

BRONCHOPNEUMONIA

The first complication which I wish to discuss with you is bronchopneumonia. The condition is present in such a large number of the cases that it is not altogether clear as to whether it should be considered as a complication or an integral part of the disease. Owing to the paucity of physical signs in many of the cases it escapes detection. Those of you who have been interested, during the height of the epidemic, in studying the causes of death as reported in the daily papers, must have been struck with the frequency with which death has been ascribed to influenza. From what I have seen of the cases which have been very ill and especially those which have died, I am convinced that bronchopneumonia or lobar pneumonia is always present, and that when influenza has been assigned as the cause of death it has been a mistake.[1]

How are you to determine the presence of bronchopneumonia? The 2 cases which I am about to discuss with you are excellent illustrations.

CASE I.—This patient was admitted to the hospital complaining of dyspnea, cough, and soreness all over the body. The illness had started a week previously. At that time he felt chilly, had some fever, sweating, headache, and cough. Later the cough became worse and he expectorated a considerable amount of brownish mucus, which was also streaked with bright red blood. At the beginning of the attack he was nauseated and vomited a good deal.

A glance at his temperature chart (Fig. 132) shows that for the first few days his fever was of an irregular type, but was gradually declining by lysis. It did not become normal for more than a day, however, when it again rose, was irregular for a few days, and finally subsided. We felt in this case that something additional had developed at the time of the second febrile dis-

[1] Since making the above statement Christian (Jour. Amer. Med. Assoc., November 9, 1918) has directed attention to the same point.

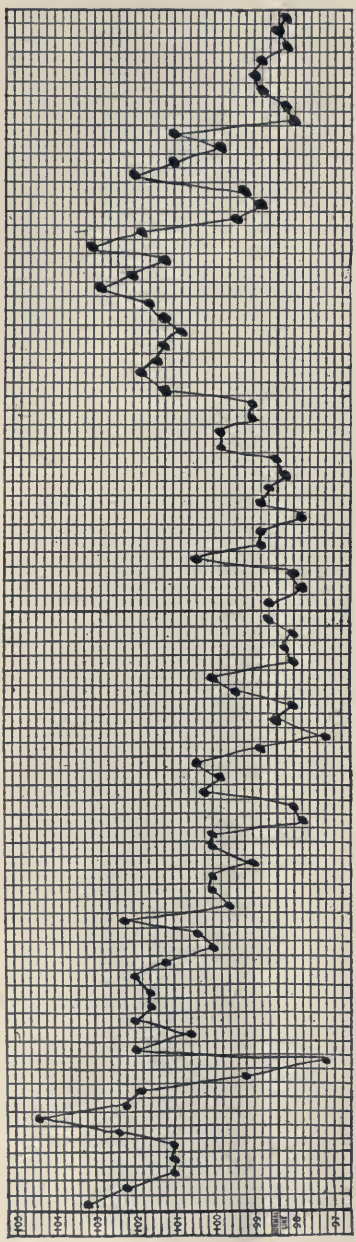

Fig. 132.—Bronchopneumonia.

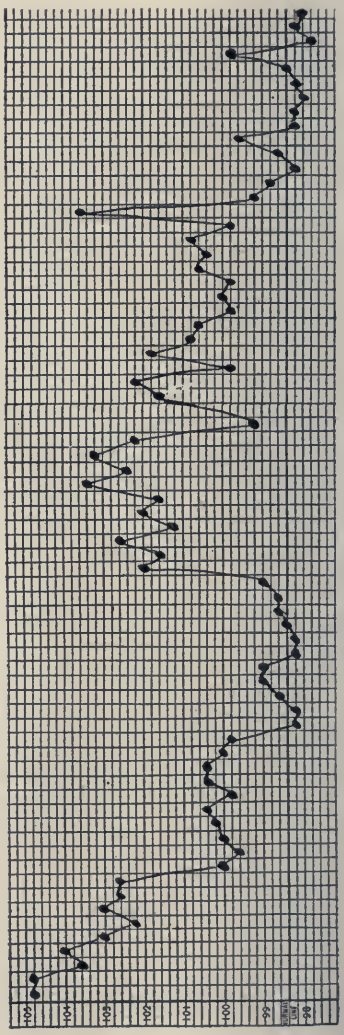

Fig. 133.—Bronchopneumonia.

turbance. An examination of his chest yielded the following information: Posteriorly on the right side near the angle of the scapula and in the immediate neighborhood of the interlobar septum there was a patch of dulness about the size of the palm of one's hand. Over this area there was distant bronchial breathing and marked transmission of both the spoken and whispered voice.

The *x*-ray examination of this case disclosed a definite patch of consolidated lung conforming to that outlined by the physical signs. It was not clear, however, whether there was in addition some fluid encapsulated in the interlobar fissure.

In this case it seems apparent that the original trouble was an influenzal bronchitis, and just as this was subsiding a small pneumonic patch developed which was responsible for the continuance of the fever.

CASE II.—This man states that his illness began three days before his admission to the hospital with malaise, anorexia, and a drowsy feeling. When we first saw him he complained of pains all over the body and sore throat. He had a cough and some mucopurulent expectoration. Physically he was a poor specimen, being anemic and under weight. The tongue was heavily coated. The blood-pressure was 120 systolic and 75 diastolic. The physical signs on admission were those of a bilateral bronchitis. There were no localizing signs.

As you will see from the temperature chart (Fig. 133) he had a high fever at the time of admission (104.4° F.). In the course of three days this had fallen to normal and remained so for one day, when it abruptly rose again. At this time he also developed marked nervous symptoms chiefly in the form of constant twitching and a muttering delirium.

Examination of the chest at this time showed that the râles had a sharp, consonating quality, especially at the right base; otherwise there were no signs of consolidation. Two days later, however, an area of flatness on percussion, distant bronchial breathing, and bronchophony were clearly made out near the angle of the right scapula. A blood count at this time showed 3,750,000 red cells, 19,040 white cells, and 75 per cent. hemoglobin.

This second case illustrates very well the danger of considering the attack over when the temperature reaches normal and remains so for a few days. No patient can be considered free from the danger of a serious complication, such as bronchopneumonia, until at least seven or eight days have elapsed without fever. We have had a number of patients admitted to the ward with bronchopneumonia or lobar pneumonia who stated that they had had fever for a few days and then gotten up, and in some instances returned to work.

Neither of these cases offered any great difficulty in making a diagnosis, as the signs of consolidation were evident. But even if most of the signs, commonly attributed to consolidation of the lung, are absent, one should rarely fail to make a diagnosis. In many instances a diagnosis can be made even in the absence of conclusive physical signs.

In the first place we have come to learn both from autopsy and *x*-ray studies that some evidence of bronchopneumonia is present in the large majority of cases. Therefore if the fever is persistent, the respiratory rate high, and the patient toxic we can be almost certain that such a condition exists.

As to the physical signs, there are two which are worthy of special emphasis: (1) Bronchophony. In case after case it has been possible to localize a small patch of consolidation by the exaggeration of the voice sounds at a given point. This will happen when bronchial breathing cannot be heard and there is no percussion change. (2) The sharp, consonating character of the râles. In no other condition with which I am familiar are the râles as sharp and metallic in quality, and this feature will often antedate for a number of days definite signs of consolidation, and may be the only tangible evidence of the condition which we can obtain.

The location of bronchopneumonic areas is usually about the angle of the scapulæ. Our experience with the *x*-ray examination of these cases has shown that the bronchopneumonic areas are almost invariably of greater extent than is shown by the physical signs.

Another interesting feature of these influenzal broncho-

pneumonias is the persistence of the consolidated areas. Not only is the febrile attack often unduly prolonged, but, in addition, even when the constitutional signs have disappeared, both the physical and *x*-ray examinations will show that there is very little clearing up of the lesions. This is to be ascribed, I believe, to the fact that influenzal pneumonias are so often characterized by inflammatory change in the interstitial tissues of the lung. There is, therefore, not only the exudate to be gotten rid of, but, in addition, the interstitial changes.

A more remote change is bronchiectasis. I have already alluded to the fact that in many cases the bronchial wall is distinctly swollen and softened. This fact, in conjunction with the relatively long-standing pulmonary changes, is probably a very potent factor in bringing about a permanent distention of the bronchi. This may explain also the fact that the one organism most constantly associated with bronchiectasis is the influenza bacillus.

TUBERCULOSIS AND INFLUENZA

From what we have already seen of this epidemic it is plainly evident that we are going to experience considerable difficulty in the next few months in regard to tuberculosis. The mistakes are going to be of two kinds. On the one hand, persistent and slowly resolving patches of influenza pneumonia, especially if located at the apex of the lung, are going to be mistaken for tuberculosis. On the other hand, known cases of tuberculosis which have undergone an attack of influenza are going to offer considerable difficulty in determining whether the increase in the physical signs is due to an extension of the tuberculous process, or whether it is a slowly resolving influenza pneumonia which will gradually clear up. The following case illustrates the first-named difficulty:

This patient had a persistent small patch of consolidation which was apparently responsible for a continuance of the fever and respiratory symptoms. He came into the ward originally because of epigastric pain from which he had been suffering for several weeks. Nine days after his entrance into the

ward and at a time other patients suffering from influenza had been admitted he developed malaise, headache, cough, rusty sputum, fever, and some dyspnea. Examination of his chest showed the signs of a diffuse bronchitis; a few days later a definite

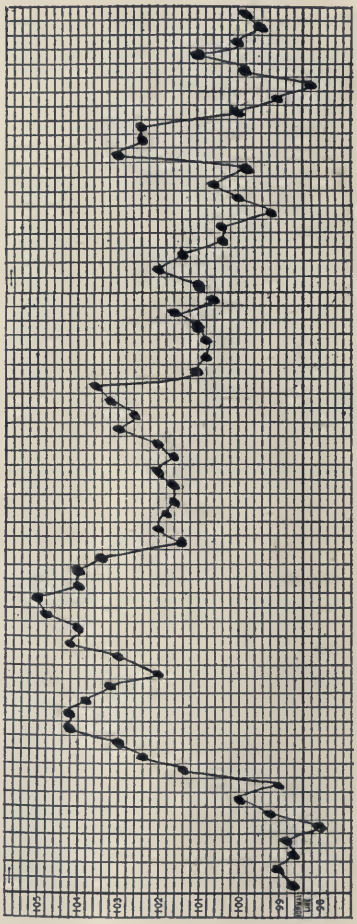

Fig. 134.—Influenza, with possible active tuberculosis following.

patch of pneumonic consolidation was made out about the angle of the left scapula.

After five or six days the temperature declined to 100° F. (Fig. 134) and kept at this level. In addition, there was a marked

increase in the amount of sputum, which was mucopurulent in character.

In view of the fact that his history showed the occurrence, eleven years before, of an illness in which the chief symptoms were cough and night-sweats, it was thought that the persistence of the fever might be due to a latent tuberculosis which had become active as the result of the influenzal attack.

Examination of his chest showed that the percussion note at the right apex was impaired, the breath sounds were rough in character, and the vocal resonance distinctly exaggerated. The sputum, however, was negative for tubercle bacilli.

The *x*-ray examination showed the presence of a sharply defined area, about the size of a silver dollar, at the level of the second rib on the right side. There was nothing in the appearance of the picture which suggested tuberculosis.

This case illustrates an important point because of the location of the consolidated area. The physical signs of a small area of consolidation or infiltration at the apex of the lung is highly suggestive of tuberculosis. Indeed, under ordinary conditions such a lesion is almost certainly tuberculous in character. During the presence of an epidemic of influenza, however, it must be kept in mind that a small patch of influenzal pneumonia may occur in and be limited to the apex. During such a time, therefore, the occurrence of fine crackling râles limited to the apex are to be looked upon as possibly tuberculous in origin, but not necessarily so.

Before the present epidemic had become generally recognized a young Italian girl came to the Phipps Institute Dispensary complaining of cough, expectoration, and malaise. Examination of her lungs showed the presence of fine crackling râles localized in the right apex. As she had slight fever the diagnosis of tuberculosis seemed more than probable. A few days later, however, she returned to the Dispensary because of general pains, and at this time fine sticky râles were heard all over both lungs. It was evident, therefore, that she had influenza and not tuberculosis.

An error in this direction is, however, not so apt to occur as

when the acute signs of the influenza have disappeared and there is left behind a small pneumonic patch at one apex which is slow in resolving. Under such circumstances it will be the part of wisdom for the duration of this epidemic, and for some months to come, to suspend judgment in such cases.

A conservative attitude must also be maintained in regard to patients known to be tuberculous and who have passed through an influenzal attack. Already I have seen several instances of this kind. It is to be borne in mind that a lung which has been infected with tuberculosis, even if the process has been arrested for some time, is extremely susceptible to acute respiratory infections, and because of the fibrous tissue and other changes about the lesion such infections are apt to persist for a much longer time than in a normal healthy lung. In the cases which have come to my notice it has not been possible to state at once whether the process is due to a lighting up of the old tuberculous lesion or whether the râles are due to the influenza attack and will eventually disappear, or, if râles have been present previously, that they will diminish.

It is the better judgment in such cases to withhold an immediate opinion. The patient should be seen at intervals, and by the end of six weeks or so it can be pretty definitely determined which condition we have to deal with, because by that time both the physical signs and the symptoms will make it apparent as to whether there has been a lighting up or an extension of the tuberculous process.

TUBERCULOUS PNEUMONIA

The next cases also introduce the subject of tuberculosis, but in a different form.

CASE I.—The patient was a male, aged twenty-two years, a tailor by occupation, who was admitted to the hospital October 13th. He gave as his chief complaints cough, pain in the chest, and jaundice, the latter having appeared the day before. He stated that he had been ill for two weeks and attributed it to working overtime for a considerable period.

His illness began with headache, slight sore throat, and cough.

The expectoration was quite profuse and of a thick, greenish, mucopurulent character. It did not show any evidence of blood. He denied the occurrence of any serious illness in the past and there was nothing of importance in his family history.

Examination.—The patient was very weak, had evidently lost considerable weight, and was markedly anemic in addition to being jaundiced. The tongue was thickly coated with a blackish looking fur. The tonsils were enlarged and the throat was congested.

Expansion of the left lung was restricted. The percussion note was markedly impaired all over the left chest. On auscultation fine sticky râles, bronchial breathing, and marked exaggeration of the voice sounds were heard over the left side.

The right lung did not show any abnormality.

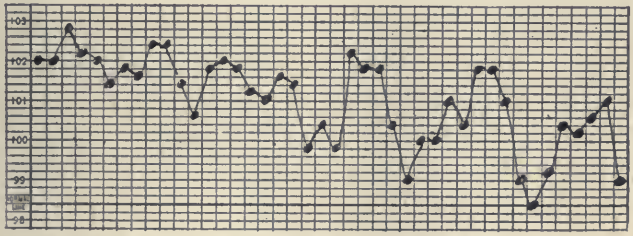

Fig. 135.—Fever chart from case of tuberculous pneumonia.

Aside from a very rapid pulse-rate the heart showed nothing abnormal.

Five days later (October 18th) the same signs were present over the left side. At this time it was noted that the temperature was becoming more remittent in type (Fig. 135). Owing to the fluctuating character of the temperature, the anemia, the emaciation, the character of the sputum, and the absence of severe respiratory distress and toxemia, so commonly seen in lobar pneumonia, a tuberculous origin of his trouble was supected. Examination of the sputum showed the presence of large numbers of tubercle bacilli. (The patient died suddenly on the tenth day of his stay in the hospital.)

Case II.—A male, aged twenty-one, was admitted to the hospital complaining of cough, headache, and pain in the limbs.

He is positive in his statement that up to four weeks ago he had been as always—perfectly well. At this time he developed a headache, felt drowsy, and had some cough and expectoration; the latter symptoms he attributed to a "cold." Although he felt badly he kept up and about, but finally had to take to his bed; a few days' rest made him feel much better, but he still complained.

He denies having had a cough prior to the onset of his present attack four weeks ago. He raises a considerable quantity of mucopurulent material; this became blood-streaked five days prior to his admission and has become more and more noticeable.

He had had no night-sweats. Since the beginning of his illness, four weeks ago, he has lost about 15 pounds.

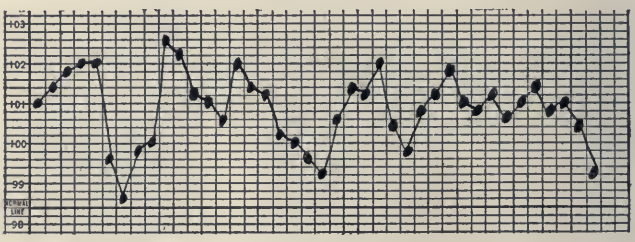

Fig. 136.—Fever chart from case of tuberculous pneumonia.

The family history is negative aside from the fact that his mother died at the age of twenty-six from causes unknown to him.

Aside from an indefinite history of rheumatism at the age of fourteen he has never been ill.

His symptoms on admission were quite characteristic of influenza. Nor was the blood-streaked sputum or the preponderance of physical signs on the left side incompatible with such a diagnosis. He had, however, a considerable amount of fever (Fig. 136), the persistence of which, in view of the length of his illness, was suggestive of something more than simple influenza or influenza complicated by pneumonia.

Examination.—A more careful examination of his chest showed some flattening beneath the left clavicle and distinct

limitation of motion all over the left chest, especially at the apex. The percussion note was markedly impaired over the upper part of the left lung and slightly so over the remainder of that side. The breath sounds were bronchovesicular in type and somewhat obscured by numerous crackling and subscrepitent râles. Aside from some exaggeration of the whispered voice at the left apex, there were no definite signs of cavity.

The heart showed nothing abnormal.

The sputum was found to contain numerous tubercle bacilli.

As in the previous case, this patient did not present the toxic appearance so commonly seen in the influenza pneumonia cases.

The *x*-ray examination showed an extensive tuberculous infiltration of the left upper lobe and the presence of two small, deep-seated cavities. The left lower lobe was the site of a diffuse, hazy, infiltrated area quite characteristic of the area of consolidation seen in influenza cases. This will, in all probability, eventually disappear. The right lung shows some scattered patches which are probably influenzal in origin.

The prognosis in this case is bad, although at present it is problematic how much of the trouble on the left side is tuberculous and how much is due to an influenza infection. It is quite possible that the signs of bronchitis over the lower part of the left lung are due to influenza and will eventually clear up.

(*Note*—six weeks later. The patient is failing steadily. Temperature hectic in type. A second *x*-ray examination shows pretty conclusively that the entire process in the left lung is tuberculous, and, in addition, there are scattered foci about the hilus of the right lung.)

Both of these patients, especially the second one, insisted that their health had been unimpaired up to the onset of their present illness. This may or may not be true. It is hard to believe that such a wide-spread process, as indicated by the physical signs, could have progressed to the present point without some manifestation of ill health. While it is quite true that similar cases are frequently seen, it is usually possible on questioning them closely to elect the information that they have felt below par for some time without, however, their being able to indicate

anything more definite than that they felt "run down" and out of sorts.

These cases illustrate very well how closely an acute and widespread tuberculous process may simulate lobar pneumonia. There is no commoner mistake in the diagnosis of chest conditions. In many cases there is nothing to suggest that the acute symptoms—such as a high and continuous fever, pain in the side and blood-streaked sputum plus the physical signs of consolidation—are due to anything else than a lobar pneumonia. The first suspicion that the condition may, in reality, be tuberculous is apt to occur when the process is unduly prolonged and the temperature begins to fluctuate widely.

I have never seen tuberculosis of the lungs which seemed to develop as the result of an attack of croupous pneumonia. For some reason tuberculous individuals, with an active lesion, seem to bear an attack of pneumonia remarkably well. On the other hand, it is a common experience to have patients, and often physicians, state that the tuberculosis followed or was caused by an attack of pneumonia. This is rarely the case. It is to be borne in mind that tuberculosis is not invariably insidious in its onset. It may begin acutely, and when the patient is first seen there may be a considerable area of consolidation at the summit of one or the other lung. In addition, the symptoms may be those commonly encountered in pneumonia. This acute attack may subside and the case remain latent for a long time; or it may become subacute and gradually merge into the familiar chronic ulcerative type of the disease; or, finally, as in the case of one of the patients under duscussion, the process may progress rapidly to a fatal termination.

How are these cases to be detected? In the first place it is to be remembered that if the process is limited to or more marked in the lower lobes, it is most certainly not tuberculous. If an upper lobe is involved and the base is clear, the lesion may or may not be tuberculous. In such cases tuberculosis is to be thought of when the fever is unduly prolonged, and especially if after a week or ten days it becomes remittent or intermittent in character. Furthermore, there is usually marked loss in

weight, sweating is common, and considerable prostration is present. Additional evidence in favor of tuberculosis are a history of that infection in the family; a more or less prolonged period of ill health prior to the onset of the acute symptoms; and the occurrence in the past of an illness which is suggestive of tuberculosis, as, for instance, a hemoptysis, an attack of pleurisy, or the occurrence of a fistula in ano. These symptoms are often spoken of as prodromal and may precede definite pulmonary manifestations by months or even years.

Since the start of this epidemic I have already seen a number of tuberculous patients who had had influenza. In nearly every instance it was impossible to tell from the physical signs whether the extension of the trouble was tuberculous in nature or whether it was due to the influenzal infection. Even an *x*-ray examination does not enable one to form a definite opinion.

POSTINFLUENZAL PLEURAL EFFUSION

We have had a number of pleural effusions developing during or after the subsidence of an influenzal pneumonia. Effusions developing during the course of an attack of pneumonia unless massive are commonly overlooked during the acute stage of the primary trouble. An effusion developing under these circumstances is commonly mistaken for a persistent or unresolved pneumonia. When you hear of a pneumonia being unduly protracted and are told that the physical signs persist, a pleural effusion is one of the first things to think of. In my experience the great majority of so-called unresolved pneumonias prove to be a pleural effusion, free or encysted or a tuberculous process. The one exception I would make to this rule is a condition so frequently seen in influenza epidemics. During such an epidemic we not infrequently encounter individuals in which a patch of consolidation will persist for some weeks.

The 3 cases which I wish to discuss with you now are of interest not only because they are excellent examples of an effusion developing after or during an influenza pneumonia, but more particularly because of the physical signs.

CASE I.—The patient was admitted complaining of cough and pain in the stomach.

He had been ill for one week. The attack began with a chill, followed by headache, pain in the stomach, cough, and the expectoration of a thick yellow sputum. For the first few days of his illness he vomited constantly.

On admission it was noted that his throat was congested and that the tonsils were enlarged and also congested.

Examination of the chest showed increased fremitus, marked impairment of the percussion note, bronchial breathing, bronchophony, and fine sticky râles over the left lower lobe posteriorly. There was a systolic murmur at the apex, but no cardiac enlargement. The blood showed 4,300,000 red cells, 4600 white cells, and 75 per cent. hemoglobin. The urine contained a few hyaline casts. At a later examination a few sticky râles were heard at the right base posteriorly.

The seventh or eighth day of his stay in the hospital the temperature dropped abruptly to normal and remained so for a day, when it rose again and continued irregularly (Fig. 137). Owing to the recurrence of the fever we became suspicious that some additional trouble had occurred.

On examining his chest it was found that the expansile movements over the lower half of the left chest were absent and the apex-beat of the heart could not be seen. Tactile fremitus was absent and the percussion note was flat. On auscultation, loud bronchial breathing was heard all over the flat area which practically coincided with the position of the lower lobe of the left lung. In addition, there was marked bronchophony and whispering pectoriloquy. The bronchophony, however, had a nasal quality (egophony), especially over the upper limits of the dull area.

In spite of the auscultatory findings a diagnosis of effusion was made for the following reasons: The almost complete lack of expansion; the absence of tactile fremitus; the flat percussion note, and the fact that the heart was displaced to the right as shown by the absence of the apex-beat from its normal position, its location by auscultation near the ensiform cartilage, and the

extension of the right border beyond the edge of the sternum. An exploratory puncture proved the correctness of the diagnosis.

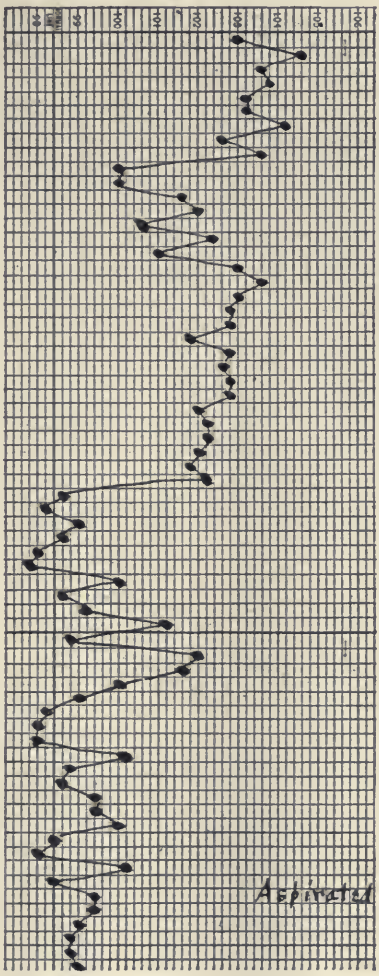

Fig. 137.—Effusion following lobar pneumonia. Often mistaken for "unresolved pneumonia."

The fluid first removed was reddish and turbid in appearance. A few days later 680 c.c. of purulent fluid were removed.

Case II.—In this case the history is much the same. The patient was admitted to the hospital complaining of cough and pain in the side.

He stated that he had been ill for twelve days and that the attack had started with a drowsy feeling, headache, pain in the back and limbs, and nausea. Three days before his admission he had a chill followed by fever, cough, bloody expectoration, and pain in the side.

On admission he had sordes on the tongue and lips, a heavy whitish fur on the tongue, and the pharynx and tonsils were reddened and congested.

There were numerous fine crackling râles in both lungs. Over the left base posteriorly the percussion note was dull, and bronchial breathing and bronchophony were heard. Four days later it was noted that the bronchophony and the bronchial breathing were distant, and anteriorly below the level of the left nipple coarse râles were heard. It is possible that the effusion was beginning at this time, because five days later the percussion note was flat, the bronchial breathing louder, and the bronchophony had a distinct nasal quality.

The heart, which was previously noted to be in its normal position, was displaced to the right.

An exploratory puncture showed the presence of blood-tinged, turbid fluid.

The physical examination of this patient gave practically the same findings as in Case I, the bronchial breathing, the bronchophony, and whispering pectoriloquy being markedly exaggerated. As in the previous case, an exploratory puncture showed the presence of a reddish-yellow, cloudy fluid.

Case III.—In this instance the patient was admitted after an illness of some eight or nine days' duration. His case differed from the previous two in the fact that the effusion developed coincidently with the pneumonia.

The patient stated that he had been ill for seven days, the attack beginning with chilly sensations, high fever, dizziness, and cough. At the time of his admission he was expectorating a considerable quantity of mucopurulent sputum which later became blood tinged.

On admission the patient was very nervous and slightly dyspneic.

The physical examination revealed the same physical signs as in the two previous cases. There was this slight difference, however, the signs were limited to the lower third instead of the lower half of the left chest, and, in addition, were not marked anteriorly. This, I think, can be attributed to the fact that he was examined while lying on his back and on his right side, thus allowing the small effusion to gravitate away from the front. In large effusions, with the consequent crowding together of the thoracic contents, the gravitating effects are not nearly so well marked as in the case of small collections of fluid.

The apex-beat was not seen, but was located behind the sternum; the right border of the heart extended well beyond the right border of the sternum.

The blood count showed 4,180,000 red cells, 6000 whites, and 80 per cent. hemoglobin. The urine contained a trace of albumin and numerous granular casts.

Fluid was suspected because of the egophony and the displacement of the heart. This was confirmed by an exploratory puncture which showed the presence of a bloody, turbid fluid.

On the third day of his stay in the hospital and the tenth day of his illness the temperature fell to normal by crisis.

How then are we to distinguish between a pleural effusion and a consolidation of the lung? In both conditions the expansion of the lung is interfered with; in both the percussion note is dull or absolutely flat; tactile fremitus should be exaggerated over a consolidation and absent over fluid, but it varies greatly, and, therefore, does not furnish sufficiently strong evidence one way or the other. Bronchial breathing and exaggeration of both the spoken and whispered voice sounds may be present over fluid as well as over consolidated lung tissue, although it is the exception and not the rule. The cardinal factor is displacement of the viscera. Thus, if the effusion is on the left side, the heart is crowded to the right, and the stomach, by reason of pressure on the diaphragm, is pushed downward, thus obliterating Traube's semilunar space. This space normally gives a tympanitic note due to the portion of the stomach which lies between the left lower margin of the lung, the right border of the spleen,

and the left border of the liver. It is a sign of relatively little value in small effusions because the weight is insufficient to displace the diaphragm downward. In massive effusions, especially if purulent, the space is usually obliterated.

If the effusion is right sided the apex-beat of the heart is displaced to the left, and if the collection of fluid is large the liver is displaced downward.

The position of the heart is really the most important consideration in these cases, and the fact that it is displaced to one side or the other can usually be determined by inspection. In thick-chested individuals it may be necessary to locate the position of the apex by means of auscultation. The point at which the heart sounds are heard with the greatest distinctness can be taken for the position of the displaced apex.

It is well recognized that in the great majority of pleural effusions there is silence over the area occupied by the fluid. Either the breath and voice sounds are feeble and distant or entirely absent. How are we to explain the fact that in some instances of pleural effusion there is a distinct transmission of both the breath and voice sounds?

Until a few years ago there was no adequate explanation. A number of hypotheses were advanced, but none of them were satisfactory.

As the result of the work of Montgomery and Eckhardt on pulmonary acoustic phenomena (Tenth Annual Report of the Henry Phipps Institute, 1915) the explanation is clear. In their study of the physics of sounds developed within the thorax they concluded that the most important factor is diffusion. The normal lung, for instance, transmits sounds produced in the larynx and carried along the trachea and bronchi very poorly because the parenchyma of the lung allows of diffusion. The result is that there is a distinct modification of the sound as it reaches the ear at the chest wall. The same is true of partially relaxed lung tissue. On the other hand, if the lung is consolidated or tightly compressed there is little or no diffusion. The application of this in cases of pleural effusion is as follows: If the lung is only slightly compressed by the effusion the bron-

chial qualities of the breath and voice sounds as they exist in the trachea are widely diffused on striking the relaxed lung, and are nearly or completely lost in passing through the fluid. Hence over the ordinary effusion there is silence. On the other hand, if the lung is tightly compressed or, as in the case of pneumonia, is still in a state of complete or partial consolidation, there is no diffusion of the tracheal sounds as they pass through the lung and, in turn, through the fluid. As a result of this lack of diffusion the bronchial quality of the breath and voice sounds as they occur in the trachea are directly transmitted to the chest wall.

LOBAR PNEUMONIA WITH RELAPSE

In addition to bronchopneumonia there have been many examples of the lobar type of the disease in the wards. Many of these cases, however, were atypical in their clinical course. The fever curve often showed distinct departures from that usually associated with frank croupous pneumonia. Thus, instead of pursuing a continuous course with slight intermissions, the fever was commonly irregular and rarely dropped abruptly by crisis. Usually the fever declined by rapid lysis. Another characteristic of the croupous type of the disease is the viscid, tenacious sputum. Indeed, this may be said to be almost pathognomonic of croupous pneumonia. In these influenza pneumonias the sputum was rarely viscid. As a rule it was mucopurulent and frequently blood streaked, but the blood was not intimately mixed with the sputum, as is the case with the rusty sputum. In addition, small hemoptyses were not infrequent. These variations are probably to be ascribed to the fact that a pure pneumococcus infection was rarely present. In addition to the pneumococcus, the influenza bacillus, the streptococcus, and other organisms also were present. Furthermore, the gross appearance of lungs the site of lobar involvement often suggested that the process was primarily a number of foci of bronchopneumonia, and that these coalesced.

It also seems to have been a common experience that the left lower lobe was the part most affected instead of the right lower lobe. In the wards of the University Hospital involvement of

the left lobe occurred in about 70 per cent. of the cases; my experience at Emergency Hospital No. 2 was similar to this.

The case I wish now to show you is an excellent illustration of a relatively rare condition, namely, a relapse. Although there is some confusion as to what constitutes a relapse, it may be said that "if a lung, after ordinary croupous pneumonia involving one or several lobes, becomes normal after the fever has terminated by crisis or lysis, the patient is convalescent; and if at least three days or several weeks after the defervescence a new infiltration of the same or other lobes with all the characteristic phenomena of a local and general routine occur, a relapse has, without question, taken place" (Wagner). A relapse is noted in about ½ of 1 per cent. of cases.

Case I.—Two weeks before his admission to the hospital the patient was apparently taken with influenza. He had a cough, yellowish expectoration, headache, and pain in the back. Three days before his admission he got up, but at once felt badly, and was shortly afterward seized with a chill, high fever, a return of the pain in his back, and an increase in the cough.

On his admission it was noted that the pharynx and tonsils were markedly congested and the tonsils were also enlarged. Examination of the blood showed 4,460,000 red cells, 5920 white cells, and 80 per cent. hemoglobin. The urine contained a few hyaline casts.

Posteriorly over the right lower lobe the percussion note was dull, the breathing bronchial in character, and the voice sounds markedly exaggerated. A few coarse râles were heard at the left base.

The temperature fell irregularly and remained normal or nearly so for four days, when it abruptly rose again (Fig. 138). This was accompanied by an increase in the respiratory rate, the cough became worse, and the amount of sputum increased.

Two days after the second febrile period developed examination of the chest showed the classical signs of consolidation over the left lower lobe. The second attack lasted for nine days, when the temperature fell by rapid lysis to normal.

The one feature that has not been affected is his pulse-rate.

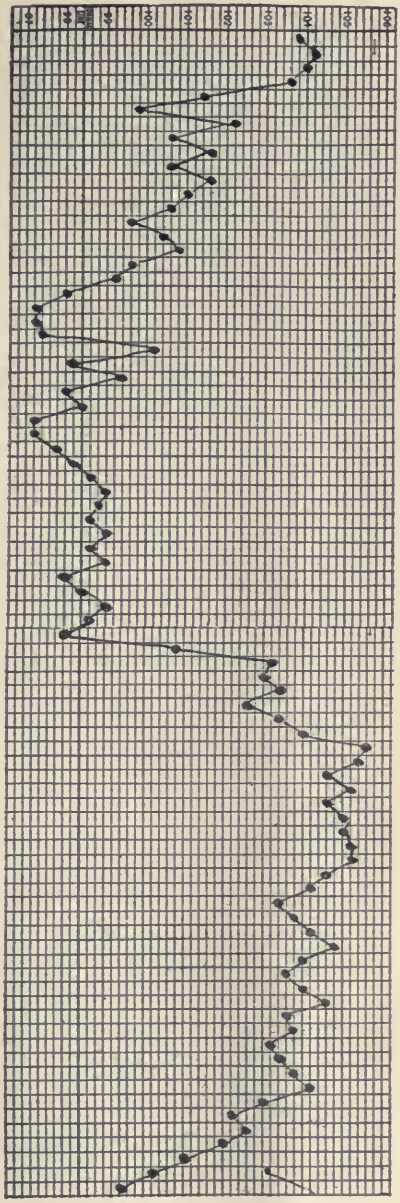

Fig. 138.—Chart showing relapse in pneumonia.

This continues unduly high and, in addition, the heart sounds lack good muscle tone. This is probably due to a slight degree of acute myocarditis. In practically all of the acute infections some degree of acute myocarditis occurs, although, as a rule, it is not demonstrable clinically. In this case the two attacks occurring so close together may have involved the heart muscle more than ordinarily.

CONTRIBUTION BY DR. JOHN B. DEAVER

THE SURGICAL COMPLICATIONS AND SEQUELÆ OF INFLUENZA

Influenza, like the poor, we have, and probably shall have, with us always. Fortunately, very severe epidemics occur at rather widely separated periods of time, and more fortunately few are so virulent and so general as the one that is now on the wane. George B. Wood, in his Practice of Medicine (5th ed., 1858), described an outbreak in Rome in 1850, during which 9000 persons are said to have died of the disease.

Since there is scarcely any part of the bodily organism that is spared some immediate or remote effect of this insidious disease, it is only natural that some of its complications and sequalæ should be of surgical importance and interest, more especially so since any latent infection is apt to flare up during an attack of influenza or during the period of lowered resistance that follows. We have lately had several cases that have recently recovered from influenza who came to operation for intestinal obstruction. The intestines were knotted and bound down by plastic exudate and adhesions resembling a tubercular peritonitis. The impression was gained that the condition may have been the direct result of the influenza, but there was no positive evidence of the fact. A number of authors have noticed an increased incidence of appendicitis in influenza years. Many of such cases most likely are so-called pseudo-appendicitis due to the gastro-intestinal symptoms that so often are part of the syndrome of influenza, and others are undoubtedly genuine appendicitis resulting from the increased virulence of the usual intestinal micro-organisms, and particularly to a predisposition on the part of the patient to appendix trouble. This explanation—lowered resistance and diathesis—undoubtedly also serves for the various neu-

ralgias, diseases of the bones and joints, as well as for phlebitis, parotitis, and other more or less unusual conditions that may follow influenza and require surgical intervention.

The term "surgical complications and sequelæ of influenza" is more apt to imply the effects of the pulmonary involvement which so frequently forms part of the picture and which is so prominent a feature of the present epidemic.

The medical aspect of the subject, especially the recognition of the presence of pus in the thoracic cavity, is of the utmost importance to the surgeon. Were we always sure of the physician's ability to make an early diagnosis of empyema, the surgeon's task would be considerably lightened, the patient's period of convalescence considerably shortened, and, most important of all, there would be much less, if any, risk of such undesirable results as displacement of the heart, deformities of the chest, and impairment of the function of the lung that may follow the more extensive operation required when intervention is long delayed.

Aspiration under proper aseptic precautions is a comparatively simple and safe procedure; oftentimes, however, owing to improper technic no liquid is obtained, and the physician being satisfied that none is present (when perhaps the pleura has not even been entered), the case goes on to chronicity. In early cases, especially in children, the fluid is apt to be serous, but even so, it should be withdrawn. When the fluid is seropurulent or purulent withdrawal by aspiration is desirable as a preliminary step to thoracotomy or rib resection. Aspiration is of the utmost value in allowing the lung to expand and the displaced heart to recover its position. The relief afforded also puts the patient in better condition for, and lessens the danger of, subsequent operation, especially if a general anesthetic is to be used.

In addition to frequent needling and the information derived from physical signs the fluroscope and *x*-ray are, of course, most valuable aids in diagnosis, in locating the collection and possible encapsulation of pus, and in indicating the most favorable point for drainage.

A rational operation for empyema is the one devised by Lilienthal, in which a wide opening in the thoracic cavity is obtained by means of a long costal incision and wide rib-spreaders. This gives ample exposure and permits the breaking up of adhesions and the removal of pyogenic membranes and allows full expansion of the lung. The wound is closed completely except for a wick of rubber tissue at each end of the incision.

In the streptococcic pleuritis observed in the extensive epidemics of pneumonia occurring during the past year at the various military training camps, it seems that late operation gave better results than early intervention. Unlike the pleuritis following ordinary lobar pneumonia the effusion in the streptococcic cases appears early; in fact, often is the first sign of infection of the respiratory tract, and operation in the acute stage, in addition to other risks, presents the danger of collapse of the lung from pneumothorax as well as a possible infection of the blood-stream from absorption of the streptococci from the fresh surfaces of the wound.

A valuable suggestion is that all pneumonia cases at the end of the second week be subjected to *x*-ray examination for early detection of any fluid that may be present and which cannot always be detected by physical signs, as, for example, an isolated abscess cavity, or when the pus is confined within a fibrous exudate, or when a slow formation of pus plasters itself over the surface of the lung in a thick layer through which the sounds of the consolidated lung are transmitted and the presence of the fluid remains undetected.

Dr. Pancoast has called my attention to the fact that the effusion in influenzal empyemas seems to show a tendency to become plastic very quickly and to wall off, so that in the majority of cases it is localized. This was found to be the case in 16 out of 25 empyemas observed at the University Hospital. As a result of this plastic exudate the pleura, even though the effusion be quickly absorbed, becomes markedly thickened, and the resulting adhesions cause crippling of the lungs.

In 35 cases treated by us at the University Hospital and at the Lankenau Hospital, 13 were interlobar empyemas, several

of which had ruptured into the lung, and in one instance pus from the general cavity had broken through into the lung. Thoracotomy except in rare circumstances is decidedly not the proper procedure for these cases, in fact, is mentioned here only to be condemned.

The operation of choice for empyema is rib resection—opening the pleural cavity and exploration with the gloved finger or the hand, thus effectively reaching all pockets of pus; flushing and wiping the cavity with Dakin's solution, and providing continuous and free drainage until the fluid returned is practically sterile. McKenna, reporting the work of the empyema team at Camp Pike, advocates the drainage of the pleural cavity in all cases irrespective of the character of the pus. He uses a No. 14 French rubber catheter and introduces it by means of a trocar and cannula just large enough to thread the catheter into the pleural cavity, connects the catheter with a 100-c. c. glass syringe, and aspirates. If the pus is too thick for aspiration a small amount of Dakin's solution is run in in order to liquefy the pus; by repeating the procedure the entire pleural cavity can be evacuated. This may be very well, but to my mind it is prolonging the agony.

The closure of the wound is a matter of circumspection unless there is a free expansion of the lung. Failure of the latter to expand is probably an indication of some latent process which may result in a recurrence of the empyema, or some deformity and impairment of function.

In 2 cases I closed the wound at once, and both have done well. This immediate closure of the wound when it can be done is useful in overcoming a possible pneumothorax, by preventing the entrance of air from without. Delbert, in a recent address before the College of Physicians, also advocated this procedure and suggested that if necessary it is an easy matter to open the suture and insert a tube.

Operation in our cases was usually done under nitrous oxid anesthesia, and consisted of resection of about 2 inches of rib, the sixth, seventh or eighth, according to indications, evacuation of the pus, wiping the cavity, and continuous drainage with

gauze or rubber, only occasionally using Carrel tubes. Faithful and intelligent dressing daily with Dakin's solution has given excellent results in our experience. We have sometimes found it advisable to discontinue the use of Dakin's solution after about ten days and to substitute carbolic, permanganate, or saline solution.

When necessary a more extensive opening is made in order to explore the thoracic cavity, break up adhesions, or search for an obscure source of pus.

One of our patients, now convalescing at the Lankenau Hospital, on the ninth day after an abdominal operation developed chills, fever, and indications of right lobar pneumonia. He coughed up about 30 c.c. of thick, bloody pus, which on examination was found to contain pneumococci and influenza bacilli. At operation one week later, after locating the pus with the aspirating needle, a vertical incision was made over the seventh rib, the periosteum removed and the rib exposed, and 2 inches of the latter resected. The pleura was then opened and 1000 c.c. of cloudy, yellow fluid withdrawn. The cavity was washed out, rubber tubes were inserted for drainage, and the wound closed. The relief following the operation was only temporary. At a second intervention, fifteen days after the first, the operative incision was enlarged, portions of the sixth and eighth ribs removed, and the thoracic cavity explored. No pus was obtained. The lower lobe of the right lung was found to be collapsed and rather hard to palpation. It was adherent to the diaphragm, but was functionating to some extent. The thoracic cavity was washed out with Dakin's solution, and the wound closed, one piece of gauze left in for drainage. The wound cavity is now being dressed daily with Dakin's solution, and the patient is making satisfactory though slow progress toward recovery. This is one of the cases of interlobar abscess rupturing into the lung, to which reference has already been made.

During the present epidemic we have treated 35 cases of influenzal empyema, with a mortality of 11.6 per cent. (University Hospital, 25 cases, 2 deaths; Lankenau Hospital, 10 cases, 2 deaths.)

In 24 cases the empyema was localized:	15 right-sided	13 interlobar
	7 left-sided	
	2 double	
In 10 cases the empyema was diffuse:	6 right-sided	
	3 left-sided	
	1 diffuse left, localized right	
The series included only	1 empyema necessitans	

Total, 35

CONTRIBUTION BY DR. RANDLE C. ROSENBERGER

BACTERIOLOGIC STUDY OF SPUTUM IN THE RECENT EPIDEMIC

Material for Study.—This consisted of sputum from about 80 cases of the disease in which bronchopneumonia was diagnosed by the clinician. Sputum was obtained in sterile bottles, brought to the laboratory as soon as collected, and cultures made after washing; spreads were made and stained with methylene-blue and also by Gram's method. The sputa were washed in two or three changes of sterile salt solution before inoculation upon the proper culture-media. In addition to the sputum, studies were also made from swabs and cultures from the nasopharynx and throats of these individuals. The spreads were treated in exactly the same manner as were those of sputum.

Culture-media.—The culture-media used were blood-agar and blood-smeared agar. The blood-agar consisted of 2 parts of agar and 1 part of blood added together at 42° to 45° C., mixed, slanted, and kept in the incubator at least twenty-four hours to insure sterility. The blood-smeared agar was made with human blood obtained from the finger, under sterile precautions, smeared heavily over the surface of the agar, and incubated for twenty-four hours to insure sterility before using. In addition to the sputum and throat spreads a few inoculations were made from the fluid which exuded from the throat and nose and sometimes the ears of those dead of the disease.

Results.—In the spreads of sputum the most conspicuous organism was a coccus which corresponded morphologically and in staining reaction to the pneumococcus. No attempt was made to determine the type of the pneumococcus. The next most abundant organism was the Micrococcus catarrhalis, which occurred in very large numbers; and then a streptococcus.

Besides these three prominent organisms we also encountered the bacillus of Friedländer occasionally; pseudodiphtheria bacilli were common and staphylococci were very noticeable. In only six or seven specimens, after a very long search, could a bacillus which corresponded in morphology and staining reaction to the Bacillus influenzæ be demonstrated. No one familiar with the classical picture of the Bacillus influenzæ could mistake it, for the simple reason that this organism is distinct as a short, thin, straight, Gram-negative bacillus occurring in clumps and usually found within the leukocytes. Filamentous forms are not common unless the organism is cultivated upon a medium suitable for it and in which involution forms occur in the very early hours of its growth.

Physical Characteristics of the Sputum.—In some of the specimens the sputum was of a bright reddish-pink color, and in others the sputum was of the ordinary yellowish or grayish-white color in which "chunks" of this reddish-pink material were present. In still others the sputum resembled the characteristic rusty sputum of pneumonia, while the majority were grayish or yellowish-gray in color with no special characteristics. In a number of spreads of specimens of sputum spiral organisms were present of variable sizes, and which no doubt represented the Spirochæta microdentia and Spirochæta macrodentia and the spirillum of Vincent. These organisms were present *only* in spreads, and were undoubtedly the result of defective teeth or of mouths which had not been properly cleansed before the collection of the specimen for study. It is my belief that their presence was of no etiologic significance.

Studies of the Throat Spreads and Cultures.—In the majority of the spreads almost the same organisms and in the same order of prominence were encountered as in the spreads of sputum. It might be mentioned that the Micrococcus catarrhalis was found in larger proportion in the throat spreads than in the sputum. The cultures showed a variety of organisms; in very few a hemolytic streptococcus was observed, and in the majority of cases staphylococci were especially common. Pneumococci, pseudodiphtheria bacilli, and in 4 or 5 cases the bacillus of

Friedländer was observed, and in about 8 of the cases a small bacillus resembling the Bacillus influenzæ.

From the fluid material escaping from the mouth, ears, and nose of those dead of the disease cultures and spreads were made, and while a few pneumococci were observed, most of the organisms were contaminating bacteria, and some, especially in culture, were of the spore-bearing variety. None of these were organisms resembling the Bacillus influenzæ.

A few blood-cultures, less than a dozen, were made, and these were all sterile.

From these studies it was learned that the bacillus of influenza or an organism corresponding to it in morphology was present in a very small percentage of cases, and from the commencement of the disease the infection appeared to be one of a mixed type.

I wish to extend my thanks to Mr. Louis Borow, Undergraduate Assistant, and to Dr. E. A. Case, Resident Physician, of the Philadelphia Hospital, for assistance in obtaining specimens of sputum for study and for the cultures from the throats.

CLINIC OF DR. CHARLES W. BURR

PHILADELPHIA GENERAL HOSPITAL

THE MENTAL COMPLICATIONS AND SEQUELÆ OF INFLUENZA

A SERIOUS feature of the recent epidemic of so-called influenza was and is (for cases of the disease are continuing to occur) the large number of patients suffering from mental complications, either delirium during, or insanity after, the acute attack. There are no accurate statistics, based on large numbers, as to the frequency of delirium during the febrile stage because in no civil hospital were there assistants enough to keep any but the briefest records. The statistics of the military hospitals will, when published, be very valuable because they are based on thousands of carefully recorded cases. Conclusions drawn from a small group of cases as to the frequency of any symptoms, mental or physical, in any disease are valueless, because in one series a symptom may be too frequent, in another too infrequent. The greater the gross number of cases studied, the more nearly will the percentage of occurrence of any one symptom agree with the real percentage. We will never have accurate statistics of the percentage of insanity following the acute illness and appearing during convalescence, because many patients are treated by one physician for the influenza, and by another, who may not know the history, for the mental disorder; and this is true not only of patients treated privately but also of those in hospitals. For example, we frequently have patients brought to Blockley, picked up by the police, about whom some vague statement is made of a recent attack of influenza. We do not count them as postinfluenzal cases because we are not sure, but more or fewer of them are; others doubtless, even if recently ill, have been in-

sane for many months. We exclude, therefore, all patients who do not have a positive history, and hence our statistics show a lower percentage than some other hospitals for the insane. Notwithstanding the paucity of statistics, there is no doubt that the percentage of patients with febrile delirium or insanity has been larger in this than in any epidemic or pandemic that has appeared in America for many years. The number becoming insane has been so large, influenza has been the exciting cause of chronic incurable dementia in so many people congenitally doomed to mental breakdown, that it is possible the number of persons insane may for several years after the cessation of the epidemic be slightly reduced, because the human material available (in other words, the people congenitally predisposed to insanity and possessing cerebral cortices abnormally susceptible to the irritation of the poison of the acute infectious fevers) will have been used up. Probably no victim of this epidemic has escaped entirely all mental disorder, though, fortunately, in a very large majority the disturbance has been trifling; the patient suffers from slight mental depression, along with physical weakness during convalescence, if he escapes more serious disorders.

This is not the place to discuss causation, but probably a part, at least, of the mental sluggishness and emotional depression is caused by circulatory weakness produced by a degeneration of the heart muscle. Fever in and by itself, no matter what its cause, may bring on delirium, but, in addition to the fever, there is also in this disease a true intoxication, a local poisoning of the cells of the cerebral cortex.

The following abnormal mental conditions are found: During the acute illness, delirium or hebetude; during convalescence: 1, psychasthenia always associated with neurasthenia; 2, a state of mild elation without delusions (very rarely); 3, confusional insanity; 4, dementia præcox, alcoholic hallucinosis, and (though very rarely) paresis. Influenza is not the true cause in Group 4, but the merest excitant.

The delirium, either excited or depressed, differs in no way from that seen in lobar pneumonia, typhoid fever, or, indeed, in any acute infectious fever. It may come on suddenly, at the

very onset of the attack, before there is any involvement of the lung. This is important to remember because a superficial examination may lead to a hasty diagnosis of acute mania, whereas a careful examination and the discovery of fever would lead to a correct opinion. Physicians sometimes forget that, barring Bell's acute delirious mania, fever is not a sympton of mania, and its persistence, if at all high, means some visceral disease. More frequently delirium does not appear at the onset, but one or two days later. Its severity varies with the rise and fall of the temperature. Moderate or slight delirium does not increase the danger of a fatal outcome, nor the chance of a later serious mental breakdown. Extreme delirium is of very serious import as to life; it is usually followed by stupor, coma, and death. Severe and continuous delirium occurring in slight fever indicates that the patient is of an unstable mental make-up and probably has not a good family history. There is one curious negative exception to this rule, namely, women of the hysteric-neurasthenic type (the emaciated, intense, and highly intellectual group, who look as if they had no power to resist disease), who certainly are victims of a biologic taint, often carry quite high temperatures well, pass through a quite severe fever with minds clearer and sometimes wholesomer, and with better emotional balance, than they show when in their every-day state. Transient delirium or stupor in high fever is not an evidence of poor protoplasm, but a normal reaction.

In some patients delirium alternates with profound hebetude, or the latter may persist throughout the entire acute illness. The profundity of the mental sluggishness varies greatly. One patient may simply want to be left undisturbed, another may require great effort to arouse him enough to take his food, and may neglect the calls of nature. True coma is, of course, rare except in patients hastening toward death. There must be some physical reason why some people become mentally excited and others obtunded when suffering not only from the same disease, but when apparently they are physically in identically similar conditions, and reacting to the same morbid stimuli, some difference in the mechanism controlling chemical changes in the

body, but what it is is unknown. When we know more of biologic chemistry and when we know more of clinical psychology, when we know how correctly psychologically to classify men, we will be able to foretell that, given certain conditions, one patient, A, will be delirious, and another, B, be in stupor.

Psychasthenia and neurasthenia are usually coexistent. They are so common after influenza that it is more correct to regard them as part and parcel of the disease, a necessary consequence, rather than as complications. The course of events in an every-day case is as follows: The patient ceases to be delirious if, indeed, he has had any delirium, his temperature becomes normal, he sleeps well, begins to want food, to digest it well, and if he has had a bronchopneumonia it passes away, but instead of regaining strength, he finds himself miserably weak, physical exertion sends his pulse-rate up and causes sweating, and he neither wants to, nor can, make any mental effort. To make a decision about some trifling matter tires him, and an important matter requiring any deep thought, for even a short time, must be put to one side. He realizes his mental weakness and, as a rule, is distressed by it, though rarely one meets a genuine philosopher who does not worry. The ordinary man is either fretful and peevish, soft, or despondent. This despondency, and it sometimes occurs independently of any serious neurasthenia, any mere physical weakness, may be so severe as to be a real melancholia. I have seen two men during this epidemic who attempted suicide, seemingly because they had, without any other symptom, lost all desire to live, so profound was their depression. Certainly there was not in either patient any outside motive—no need of money, no family quarrel, none of the things that drive sane men to suicide—nor did they act under the influence of a delusion, unless it came into their minds at the moment of the attempt. In both cases no one suspected, though everyone knew they were much depressed, that they needed constant watching. As sometimes happens after attempts at suicide, one patient lost his depression almost at once; the other continued depressed for several weeks, but now seems normal. Both stated, on recovery, that they tried to kill themselves because they

were horribly down-hearted and could not convince themselves they would ever feel otherwise. Another man tried to kill himself because he had been told, what was not true, that he had not only influenza but also phthisis. He had a family to support and, brooding over his condition, decided to end it all. In his case there was an external motive, but (and I can speak, for I knew him well) he would not have dreamed of suicide had he not been made despondent by his acute illness.

The outlook as to complete recovery from postinfluenzal neurasthenia and psychasthenia is absolutely good. Even profound simple melancholia is almost always recovered from. Indeed, unless there appear delusions of self-accusation recovery is almost always certain to come after some weeks, and even with the delusions, after several months. Every patient, however, who is profoundly depressed should be watched and studied as to his true emotional state. Too often we neglect the emotional study of patients. For example, a youth twenty-two years old was admitted to a hospital with a temperature of 103° F. His fever continued between 101° and 102° F. for four days, and on the sixth day fell to normal and remained there. He had no definite signs of any extensive lung involvement, and in ten days from the onset began to sit up and walk about. In fourteen days he began to do little jobs around the ward, was quiet, talked very little to the other patients, but seemed anxious to be kept busy. (I suspect he wanted to keep occupied in order to stop thinking.) No one paid much attention to him until, on the twenty-first day after his admission, he was, by the purest accident, caught just as he was about to jump off a fire-escape at the fourth or fifth story. He was, when found, dazed and confused, and was sent to another hospital, where I saw him. On my first examination he was too apathetic for me to learn much about his mental condition, and remained so several days, needing to be spoon fed, but not unclean, not noisy. A few days later he began to talk and to blame himself because of his habit of masturbation. He constantly accused himself of sinning against God. He rapidly demented. In his case the influenza was merely the exciting cause of an adolescent insanity which was sure to

come sooner or later. I report him here as showing how important watchfulness is to prevent suicide.

Very rarely during convalescence a patient, instead of feeling neurasthenic and mentally depressed, feels a little elated and imagines he is stronger than he really is. He is not grandiose, has no delusions of grandeur, but is simply a little too happy. This abnormal emotional attitude never lasts long, and the only danger from it is that the patient may dismiss his physician too soon, overexert himself, and die suddenly from his weakened myocardial muscle being overworked, or the physician may mistake the elation for genuine good health, dismiss himself, and later be blamed for the death.

The true insanities occurring in influenza come to the surface, as a rule, during convalescence. I say "come to the surface" because they have been potentially present since conception. It is unusual for the delirium beginning in the febrile stage to continue after the fever ceases and to become chronic. Patients who are going to become insane after the acute attack, as a rule, show no very marked mental symptoms during the febrile stage; or there may be delirium, which passes off, and is succeeded by a period of mental clearness, followed by insanity. The symptoms of insanity begin to appear several days or several weeks after the beginning of convalescence. The most common clinical picture is that of confusion. There may be fleeting hallucinations of sight and hearing, periods of mental inertia interspersed with periods of active but confused thought. The patient may be able to appear, indeed be, mentally clear for a moment or two. For example, he may start to answer a question responsively, but before he has spoken many words will wander and talk incoherently. The hallucinations are usually unpleasant, indeed, horrible. Rarely they are pleasant. Patients more often hear the cursing of devils than the singing of the heavenly choir. Hallucinations of taste and smell are much less frequent than those of sight and hearing. Delusions also occur. One young married woman believed she had had a miscarriage and so accounted for being in bed. She was much confused, but always came back to the miscarriage. One moment her husband was

dead, and the next he had married a second wife, the wife being any nurse within her field of vision at the time. At times she was elated, singing and shouting; at others apathetic, emotionless. Within four weeks mental health began slowly to return. On the whole, the prognosis, both as to life and as to recovery, is good in these cases of acute confusional insanity, and, as a rule, the duration is five to eight weeks. The shorter the attack, the less likelihood of a recurrence of mental disorder, either after stress or spontaneously.

Most serious of all the mental complications of influenza are the cases in which it simply hastens, simply precipitates, the occurrence of an insanity. Youths or young adults, predestined to an adolescent insanity, a dementia præcox, are especially prone to break after an attack of influenza. I believe, though I cannot prove it statistically, that influenza, especially when it is associated with a bronchopneumonia, is much more dangerous, as an exciting cause of dementia præcox, than typhoid fever or lobar pneumonia, though even it is not a frequent cause, most cases of dementia præcox arising from endogenous, not exogenous, causes. Usually whatever type of adolescent insanity appears as the final state, the beginning is confusion; later there may be catatonia or a paranoid dementia. All of the patients presenting a true insanity whose histories I have been able to get showed a family taint; either insanity, hysteria, epilepsy, or degeneracy of some kind had been present in one or more of their near kin.

Influenza seemed to be the exciting cause in two cases of paresis or, rather, seemed to bring out the mental symptoms. Both patients were young men, one thirty-eight the other thirty-five years old; one had had a chancre five years before; the other, three. The families, in each case, denied the existence of any sign of mental disease before the acute illness appeared. Both the patients had grandiose delusions and were demented. One had scanning speech and increased knee-jerks, and the other had pupillary inequality, with poor reaction to light and exaggerated knee-jerks. Both had the paretic facies. The physical signs, caused by spinal cord degeneration, could not have been the result of the influenza, and must have existed before the onset.

I am forced to believe that both were cases of paresis beginning with physical symptoms and that the influenza hastened the appearance of the mental symptoms.

I have seen quite a few children from eight to twelve years old, all of whom were delirious, and five of whom died with pneumonia during the delirium, or, rather, in a consequent coma. In several of the children there were distinct signs of meningitis, and had I seen them in the epidemic of poliomyelitis in 1916, I should have diagnosed their cases as being instances of the meningeal type of that disease. I may add, though it is a little away from the subject of this paper, I have seen several children who, without mental symptoms, showed the spinal-cord-symptom picture of the same disease. Have there really been two or three different epidemics running concurrently, or does influenza do all the remarkable things seen this year? The first assumption is the safer. I can draw no conclusions as to the frequency of mental involvement in children suffering from influenza, because I have only an opportunity to see those mentally or nervously affected.

Let me say a few words as to the effect of influenza on people already mentally defective. I have seen four imbecile children who were attacked. One, a girl fourteen years old who had been simply feeble-minded, became violently delirious during the fever, hallucinatory and delusional later, and finally had to be sent to an institution, where she now (three months later) remains. She is dirty, destructive, foul-mouthed—a complete imbecile. The other three were children from eight to ten years old, who, though feeble-minded, had not needed institutional care. They were mildly delirious at first, and so much degraded later that they could not be kept at home. In all, therefore, the influenza caused a very rapid and permanent increase in the already present mental weakness. This is not always the case; many imbeciles, I have been told by physicians in institutions, pass through an attack and are the same after as before.

It is an interesting fact that patients suffering from what we call chronic mania, as a rule, or at least it has been my experience, become stupid and apathetic during the fever. Off hand, one

would expect they, of all men, would become delirious. On the contrary, the fever, or the poison of the disease, has a sedative instead of a stimulating or irritating effect on them. Most of those whom I saw, who survived, are in almost the same mental state they were in before; a few are distinctly demented. Paretics, who have mind enough to be influenced, seem to be affected in the same way as maniacs. It is important to keep a keen eye on the insane at all times, and especially during an epidemic, lest they be neglected while ill, because they are prone to a mental anesthesia of the viscera, in consequence of which they may be attacked by inflammatory or other pathologic processes which would cause pain in the normal man, without showing any sign of suffering, without any complaining.

Alcoholics (and let me say by that word I mean the congenital degenerates who have an abnormal craving to drink to excess, and the silly fools who, being lazy, get drunk constantly because they have nothing better to do, not sane men, who use liquor sanely) do not withstand any acute infection, including influenza, well. They are prone to develop delirium tremens or some other type of alcoholic psychosis, and the outlook as to life is always bad.

The treatment of febrile delirium resolves itself into a question as to whether, in a given case, the delirium or the sedative will do the more harm. Measures to reduce the fever, if high, are, of course, always indicated. Frequent sponge-baths are very useful for this. The same antipyretics are used as in any febrile state. Sedatives are contraindicated unless the delirium is so intense as to be really exhausting the patient and preventing sleep. The old-fashioned opium mixtures are still useful in this condition. The synthetic drugs, especially those which depress the heart action, should be used only when absolutely needed.

The sheet-anchors in the treatment of postinfluenzal psychoses are food and rest, followed by food and exercise. It is doubtful if the old explanation, of mere exhaustion alone, explains the mental disorders following the acute infectious fevers, but rest and quiet are most important elements in treatment. In conditions of mental excitement the continuous warm bath

often has a very quieting effect. The patient pays no attention to his bowels, and hence constipation is common. This must be overcome by some laxative that will not purge, but cause one or two stools, and the more nearly normal the stools are in color, consistency, and amount, the better. Continued purgation is harmful. When the patient will co-operate in the matter of eating, he may have a mixed diet, with milk between meals and at night. It is necessary to remember that many patients will not chew food, and such cases must be kept on a mushy and liquid diet. When the patient is in a condition of simple stupor, or catatonic, he must be fed by the nasal tube. One quart of milk, two ounces of sugar, and two eggs, beaten up together, and given twice daily, will give sufficient nourishment. During the period of physical weakness massage is very useful. So soon as the patient is physically able be should be given exercise out of doors. If he can be induced to enjoy any outdoor sports he is on the high road to recovery. It is useless, indeed harmful, to attempt mental stimulation by mental exercise until the patient is well enough to co-operate.

CONTRIBUTION BY LIEUT. EUGENE A. CASE, M. C., U. S. N. R. F.

BACTERIOLOGY OF INFLUENZA

THE pandemic of influenza just passed is but a repetition of similar ones, though perhaps more virulent than most of them, and it will be interesting to pause for a moment to glance at the explanations given for the earlier visitations of the scourge.

In the absence of exact knowledge as to the cause of disease it is but natural that those who practised and taught the art of medicine should be influenced by various natural phenomena occurring coincidently with epidemics, and should have given rather free rein to theorizing, a characterstic by no means rare at present.

In 1510 and even as late as 1762 the appearance of a comet at the time of an epidemic was looked upon as more than a mere coincidence.

Volcanic eruptions, such as those of Ætna in 1556, 1675, and 1762, Vesuvius in 1737, Hecla in 1781, with their discharge of noxious vapors and dust; offensive fogs, as in 1537, 1775, 1782, and 1831; damp cold winters following unusually hot and dry summers; swarms of flies and locusts; distempers in horses and cattle—all these were considered in the etiology of influenza, and careful studies have been made of the meteorology of various sections with the purpose of determining whether or not the weather was an important factor.

It was pointed out by some, however, that the rapid and universal spread of the disease and its existence in various climates, favorable or otherwise, rather militated against this theory. The present epidemic has shown very conclusively that climate had no part in either its production or its spread.

In 1850 John Groves,[1] of London, published as his opinion that a living germ was the cause of the disease.

Peacock[2] thought contagion played an occasional part in the spread of influenza, but by no means the most important one.

One writer, Basle, thought ozone a considerable factor in the production of the disease.

With the demonstration of micro-organisms as the cause of infectious diseases it became clear that epidemics depended upon the rapid spread of these organisms from individual to individual, and in the case of influenza they spread along the lines of human travel and at about the same rate.

At the time of the epidemic of 1889–92 many men whose names are now familiar to every physician and who founded the science of bacteriology, worked upon the problem, but were unsuccessful until Pfeiffer demonstrated the bacillus which bears his name in 1892.

It is interesting to note the resemblance in the reports of the studies of that epidemic and the present one.

Dr. Kline[3] examined a number of bood-films, made 43 blood-cultures, and believed that he found a minute bacillus in all of his cover-slip preparations and in six of his blood-cultures. Others making similar experiments were unable to confirm his results, and during the present epidemic blood-cultures have been uniformly negative so far as the Bacillus influenzæ is concerned.

Kline also cultured the bronchial secretions, using a slightly alkaline broth, and was able to confirm Pfeiffer's discovery, finding the bacilli most numerous in the early stage of the disease. His experiments with animals were negative. In one autopsy he isolated the influenza bacillus.

P. Canon[4] felt convinced that he had demonstrated the bacillus in cover-slip preparations, and was supported by Koch, but J. H. Wright,[5] of Boston, pointed out the very obvious possibilities for error in his work. Pfeiffer and others were never able to demonstrate the bacillus in blood-films.

Klebs,[6] in studying the blood from cases of influenza, found "an enormous mass of small, actively moving, highly refractile corpuscles," and thought because of the recurrences or relapses in the disease that it might be due to a protozoan.

Ribbert,[7] studying the lungs from cases of influenza, found the streptococcus, especially in lungs where no consolidation was present.

Weichselbaum[8] found the pneumococcus in the sputum in nearly all cases, in the urine in one case, in inflammations of the accessory nasal sinuses, in otitis media, and in one case of a complicating meningitis. He was unable to isolate anything from the blood. He believed the cause to be an organism as yet unknown, but felt that the pneumococcus played an important rôle as a secondary invader.

Babes[9] described two organisms which he called Bacterium No. 1 and Bacterium No. 2. The former, a minute bacillus, was Gram-negative, formed fine rods, or was even pear shaped.

His Bacterium No. 2 was somewhat similar in morphology and growth, though larger, and Gram-positive.

Finkler[10] describes pneumonias similiar to those seen in this last epidemic, speaking of the consolidation as being splenized rather than hepatized. He secured the streptococcus from the lungs, and in only one case a staphylococcus and a diplococcus, not the pneumococcus.

Levy,[11] studying the cases at the Strassbourg Clinic, found in the sputum, in pus from otitis media, and from the pneumonias pneumococci, streptococci, and staphylococci, but did not believe them to be the cause of the disease.

R. Pfeiffer[12] in January, 1892, summed up his discoveries as follows:

1. A definite species of bacilli found in all cases of influenza studied. In uncomplicated cases they were in pure culture and in immense quantities as a rule. They may penetrate the bronchial tubes and invade the peribronchial tissue, and even reach the pleura, as in one case.

2. They were found exclusively in influenza cases.

3. Their presence kept pace with the course of the disease, decreasing in number as the patient improved.

4. He had seen and photographed similar bacilli in enormous quantities two years ago.

5. They were small rod-like organisms that sometimes grew

in short chains, and did not stain well with most of the aniline dyes. They were immobile, and because of their peculiar staining some of the earlier observers who evidently saw them took them for diplococci.

6. They grew on 1.5 per cent. sugar-agar as extremely small, clear droplets that could not be seen at times without a lens. He could not cultivate them beyond the second generation.

7. Inoculation experiments were conducted with apes, rabbits, guinea-pigs, rats, pigeons, and mice, but were positive only in rabbits and apes.

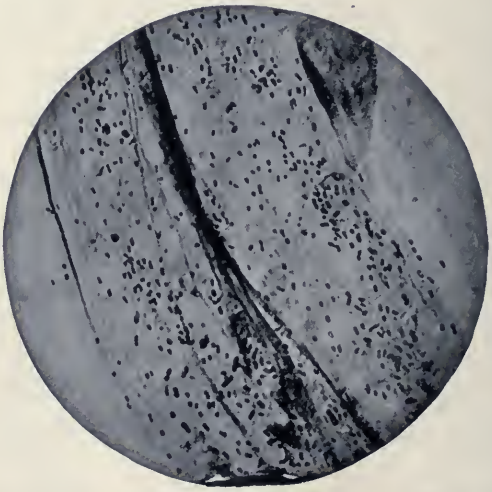

Fig. 139.—Bacillus of influenza. Smear from sputum (after Heim).

8. He felt justified in calling this organism the cause of influenza.

9. The infection is spread by way of the sputum.

Kitasato[13] thought it remarkable that the organism had not been discovered before, but believed this to be due to the extreme difficulty in securing a pure culture.

The Bacillus influenzæ is small (0.2 x 0.5 μ), possesses no flagella, is not motile, and forms no spores (Fig. 139).

It is best stained with a 10 per cent. aqueous solution of carbolfuchsin or with hot Löffler's methylene-blue. We found a useful routine method to be Gram's, followed by 10 per cent.

carbolfuchsin as the counterstain. This brings out both the organisms positive to Gram's and those negative, the influenza bacillus being among the latter.

They are commonly very numerous in the sputum from an early case, and appear as minute rods suggesting diplococci at times because of the polar staining. In preparations made from cultures they show variations in size and shape, being much less uniform than in the secretions from the respiratory tract.

The earlier workers used glycerin-agar and nutrient broth for cultivating them, but had great difficulty in keeping the organisms alive for more than two generations. Pfeiffer later discovered that they grew best when blood was added to the media. They belong, therefore, to that group of organisms known as hemoglobinophilic, *i. e.*, organisms that require hemoglobin for their best development.

A satisfactory medium is nutrient agar titrated to plus 0.5 per cent., to which 0.5 per cent. of defibrinated, unlaked human or rabbit's blood is added.

Another is nutrient broth with the same reaction, containing 1 per cent. of sodium citrate and a small amount of human or rabbit's bood.

We have found these exceedingly useful media not only for the influenza bacillus but also for the streptococcus, pneumococcus, and (when sugar is added) for the meningococcus also. Sheep's blood may be used and it may be laked, though we have thought the unlaked blood to be more satisfactory.

In isolating the organism from sputum or other secretions the material is first planted on blood-agar plates, incubated for twenty-four or forty-eight hours, the plates carefully examined, and the favorable looking colonies picked.

These are planted in broth containing a small amount of blood and 1 per cent. sodium citrate.

After twenty-four to forty-eight hours the broth culture is smeared over a blood-agar plate with a sterile swab and incubated. If the influenza bacillus was present in the colony picked, it can be easily isolated in pure culture by this method.

On agar the colonies are minute, colorless, and may escape

detection unless the plate is very carefully examined, using a lens.

With a heavy growth the colonies can be seen quite readily, especially if the plate is held at the right angle to the light. The colonies remain discrete (Fig. 140).

In bouillon containing blood the bacteria commonly form small "woolly" masses usually lying on the surface of the blood, though they are also found at the surface of the media. When

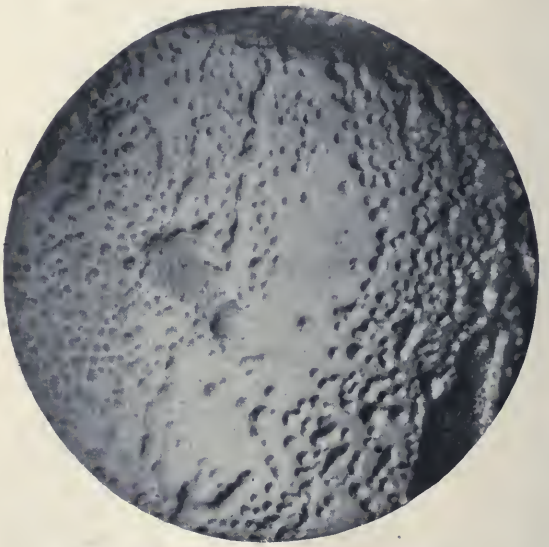

Fig. 140.—Bacillus of influenza. Colonies on blood agar-agar. Low magnifying power (Pfeiffer).

the culture is young the meida is perfectly clear, but later clouds slightly.

The bacteria grow best at 37° C., and are very susceptible to unfavorable conditions, such as extremes of temperature and drying.

Pfeiffer recovered the organisms from cases of true influenza, grew them upon artificial culture-media, transmitted the disease to monkeys by inoculating their nasal mucous membranes with cultures of the bacillus, and was able to recover the organism

from the sick animals. The organism has, therefore, been accepted as the cause of influenza.

Because of the frequency of relapses and subsequent reinfections it has been believed that immunity was not conferred by an attack. Experiences during this past epidemic, however, raise the question of immunity afresh, as most of the individuals attacked were under forty years of age.

This may be explained by an immunity developed as the result of a previous attack, though the question cannot be satisfactorily answered as yet.

The disease is extremely infectious, the contagion being spread through the secretions of the respiratory tract, discharged by coughing, sneezing, or spitting.

Because of the rapidity of the spread of the disease, the short incubation period, and the wide-spread infection quarantine measures proved to be impracticable. In one western city the wearing of masks was compulsory, and it will be interesting to learn if this practice reduced the number of cases.

The use of masks by those in contact with patients is to be recommended, though the masks must be properly made and other precautions taken, such as care in adjusting the mask, cleanliness of the hands, etc.

In the earlier part of this paper a few reports from an extensive literature on this subject were quoted, and show the failure of many bacteriologists to demonstrate the influenza bacillus. Other organisms were isolated, such as the pneumococcus and streptococcus, especially in fatal cases and in the pneumonias, a fact of striking interest in view of the findings during the present epidemic.

Little, Garafallo, and Williams[14] failed to find the Bacillus influenzæ, but did find a Gram-negative diplococcus in all of their cases.

Gotch and Whittingham[15] found the Bacillus influenzæ in 8 per cent. by cultural methods and in 62 per cent. in stained smears from the sputum, and attributed the infection to a Gram-negative coccus "perhaps in association with the influenza bacillus."

Averill, Young, and Griffith[16] were able to cultivate the Pfeiffer bacillus from the sputum.

Matthews,[17] using a trypsinized blood-agar medium, found this organism in all of 12 cases studied. His cultures were taken from the nasopharynx by means of the West tube.

Martin[18] found the influenza bacillus in smears and cultures, and believes the epidemic to be true influenza.

Krumbhaar,[19] in a short note to the Lancet, takes issue with Little, Garafallo, and Williams, finding the influenza bacillus in three-fourths of a small group of cases.

Keegan,[20] in this country, had rather unsatisfactory results from sputum cultures and mouse inoculations, but found the influenza bacillus in some of his cases. In cultures from the lungs, however, in 23 cases, taken at autopsy, he was able to isolate the organism in 82.6 per cent., 31.6 per cent. being pure cultures.

Nuzum, Pilot, Stangle, and Bonar[21] found the influenza bacillus in only 8.7 per cent. of over 2000 cases, a study conducted at Chicago. The most important and the predominating organism was the pneumococcus, though the streptococcus, staphylococcus, and Micrococcus catarrhalis were present in varying numbers.

Synnott and Clark,[22] at Camp Dix, found the influenza bacillus in the majority of cases where searched for in association with the Micrococcus catarrahalis, Streptococcus hemolyticus and viridans, and the various types of pneumococci. They did not find the influenza bacillus in the blood, which agrees with the experience of others.

At the United States Naval Hospital, League Island,[23] the influenza bacillus was isolated in pure culture in but 4 per cent. of cases, though it was present in a larger percentage in other plates. Blood-cultures were negative so far as the influenza bacillus was concerned. In one case a Type 4 pneumococcus was isolated from the blood. Various types of pneumococci, streptococci, and micrococci were found in the cultures examined.

The pathology of influenza is concerned not only with the effects of the influenza bacillus and its toxin, but with the

damage resulting from secondary invasion of other organisms as well.

The latter, in fact, account for the large majority of the serious consequences.

The toxin of influenza acts somewhat in the nature of an aggressin, breaking down the body defenses and rendering secondary invasion much easier and more serious. For example, Type 4 pneumonias have been more virulent when associated with influenza than when the primary and only infection.

The mucous membranes are intensely congested, especially the conjunctivæ and those of the respiratory tract. Epistaxis is common, and in rare cases bleeding from the stomach and bowels has been reported.

Coryza with mucous discharge is not a common symptom, though frequent in former epidemics.

The inflammation of the lower respiratory tract soon changes from the congestive stage to that of cellular infiltration and excessive mucous formation, and the cough, at first dry, is now accompanied by a mucopurulent discharge.

This inflammatory change involves the bronchi as well as the larynx and trachea, and in severe cases of bronchitis bronchiectasis may occur.

From inflammation of this sort it is but a step to invasion of the lung, with the development of consolidations. The pneumonia which occurs is usually lobular and bilateral, though much more marked in one lung than in the other. The right lower lobe is most frequently involved, but in fatal cases this is but the forerunner of involvement of the other lobes.

The lesion begins in one or more foci and extends until practically an entire lobe is affected, sometimes an entire lung. The pleura shows well-marked pleuritis, which in some cases is characterized by an extensive fibrinous or serofibrinous exudate. The purulent form (empyema) occurs as a sequel rather than as a coexistent complication.

In this epidemic it has not been as common as during the pneumonia epidemic of last winter.

The appearance of the cut surface of the lung varies with the

character of the infecting organism and the age of the various processes. In one case the lung presented a mosaic of dark red, moist, air-containing areas, dark red glazed consolidations, reddish-gray granular ones, others similar to gray hepatization, and still others showing very early resolution. In this case the lesion was, anatomically, lobar in character, but it was essentially a lobular pneumonia that by extension had involved the entire lobe.

Pericarditis and endocarditis have been reported, though lesions of the cardiovascular system of this sort are not common. The toxin has undoubtedly a pronounced effect on the cardiac mechanism, as can be observed in the relatively slow pulse, the low blood-pressure, and the cyanosis which is so common in the severe cases.

Evidence of severe irritation of the kidneys is seen in the large number of cases showing albumn and casts in the urine. The kidneys examined at autopsy show acute parenchymatous nephritis.

Severe lesions of the gastro-intestinal tract are uncommon, but definite cases of enteritis with hemorrhage have been reported.

The liver shows cloudy swelling and the spleen is frequently enlarged, sometimes being of the so-called "splenic tumor" type.

Middle-ear disease with its attendant dangers and complications has been prominent in earlier epidemics, and is not rare in this one. The same is true of lesions of the accessory nasal sinuses. In these conditions a complicating organism is usually recovered.

Myositis, arthritis, encephalitis, myelitis, neuritis, and psychic disturbances, such as melancholia and mania, have been described.

Considerable doubt has been expressed as to the etiologic relationship of the influenza bacillus with the epidemic just passed, founded upon the contradictory reports given by various workers. While the investigation as a whole has been very unsatisfactory, nevertheless, taken with the clinical history, we feel justified in believing this true influenza.

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12. R. Pfeiffer: Deutsche Med. Woch., January 16, 1892. Quoted in Medical News, January 30, 1918.

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CONTRIBUTION BY DR. J. LESLIE DAVIS

NOSE, THROAT, AND EAR AFFECTIONS COMPLICATING OR FOLLOWING THE RECENT EPIDEMIC OF SO-CALLED INFLUENZA, WITH A VENTURED INTERPRETATION OF THEIR SIGNIFICANCE

From an incomplete review of references to nose, throat, or ear phenomena in recent discussions on the influenza epidemic, whether in official or individual reports from large army, naval, or civilian hospitals, or whether from observations by private practitioners in large cities or isolated rural districts, regardless of longitude, latitude, or altitude, there seems to be a common agreement that practically all cases of so-called influenza, at some stage, if not throughout the course of the disease, manifested symptoms, varying from slight discomfort to marked distress, of the upper respiratory tract.

The most characteristic feature of these conditions, however, has been their utter lack of any characteristic order, mode of invasion, or degree of persistence. There was no group of symptoms nor even one symptom manifested in all cases, though collectively those commonly observed were nasal congestion, epistaxis, headache, sinusitis, pharyngitis, laryngitis, otitis media, and mastoiditis. In other words, there evidently exists no upper respiratory syndrome peculiar to the disease or in any wise different from those manifested in ordinary infections or irritations of the same structures. Two of the most common symptoms occurring in the early stages, one objective and the other subjective, and of particular interest in this connection, are headache and epistaxis, each of which may be accounted for as a purely mechanical process and probably very largely dependent upon another frequently associated condition, namely, low blood-pressure.

Observations for some years have led me to believe, regardless of the exciting or contributory influences, that the direct mechanical cause of the majority of headaches, at least in their early stage, is located in the upper or ethmoidel area of one or both nasal chambers, being either a pressure irritation of the nerves, or else a toxic irritation through interference with sinus ventilation. This may be due to the constant existence, in those habitually predisposed, of some form of obstruction (deflected nasal septum, enlarged or misplaced middle turbinates, granulations, or polypoid growths, etc.), further aggravated in each attack by toxic absorption from diseased tonsils, acute or chronic indigestion, intestinal auto-intoxication, or marked atmospheric changes, etc.; or else, in those not so predisposed, it may be due to the intensity of some acute process causing marked congestion or swelling of the membrane in the ethmoidal region.

I have seen numerous cases of headache relieved temporarily by reducing the swollen, intumescent or engorged nasal membrane with applications of an astringent solution, and its permanent relief when the local reduction of pressure was followed by correction of the predisposing constitutional or systemic factors without resort to any local surgical procedure. Of these, intestinal toxemia is perhaps the most common, resulting frequently from a condition of hypocholia, which, in turn, is likely the result of toxic absorption from some focal infection of which the faucial tonsils are the most common and most constant offenders.

The premonitory headache in certain acute infectious diseases I believe to be mechanically produced in the same manner, its severity depending upon the degree of existing local predisposing factors; its persistence depending upon the prolongation of the toxic source or else the possibility of an ensuing sinus infection.

The phenomenon of epistaxis, likewise, may have both a local and a constitutional predisposing element. For instance, probably 90 per cent. of such hemorrhages emanate from a small area on either side of the nasal septum near the anteror margin, where the mucous membrane is prone to become dry and, in the case of more or less catarrhal irritation, "crusty," so that small

branches of the septal artery which run exceedingly near the surface at this point may be easily ruptured by cracking of the membrane in this dry space. A somewhat similar process may take place in the early, dry, congested stage of an acute rhinitis, and, once started, may persist or recur at intervals according to the continuation of certain constitutional factors, such as pyrexia, toxemia, blood-pressure, etc.

Thus my object in dwelling upon these symptoms, headache and epistaxis, commonly referred to in influenza reports from all sections of the country, is to emphasize the mechanical processes engaged as found commonly recurring in the initial stages of various ordinary acute infections. And even all the other symptoms enumerated seem to be in nowise different from the same phenomena occurring in the beginning or during the course of the common affections or infections of the upper respiratory tract and its closely associated structures.

For the purpose of comparing and contrasting certain phenomena of the epidemic and those of a similar character observed at other times, I wish to quote from several recent reports from large Army, Navy, and Civilian Hospitals.

These extracts had to be taken more or less at random from general reports, since up to the present time I have been unable to find any published observations especially on the subject of nose, throat, and ear complications or sequelæ.

Alfred Friedlander et alia, in the Camp Sherman report (Jour. Amer. Assoc., November 16th), state: "Other than pneumonia, complications to influenza were slight. Profuse epistaxis without nasal ulceration was very frequent at onset, and later acute catarrhal otitis media was common, but fortunately always cleared without perforation of the drum. Hemorrhages into the middle ear and a few instances of acute sinusitis occurred."

From Lieut.-Commander Daland's recent discussion before the College of Physicians, on characteristics observed at the Philadelphia Naval Hospital, is the following: "Onset variable, may be slight coryza, dry cough, loss of voice, epistaxis, pains in head, back, and limbs, slight fever, marked circulatory de-

pression, intense toxemia affecting vasomotor and cardiac apparatus."

Bernard Fantus, Rush Medical College, Chicago: "One of the startling features of the pandemic was its sudden flaring up and its equally sudden decline. Among those who escaped well-marked sickness there are few who could not recall having had an occluded or running nose, a raw feeling in the throat, or a cough or ache or pains at some time during the period of prevalence of the disease. In view of the universal prevalence quarantine seemed useless and face masks were not prophylactic —nurses who wore masks were largely susceptible. Nose not as frequently affected as bronchial tubes; when it was involved, showed marked tendency to bleed. Throat rarely complained of."

Nuzum and Associates, from the Laboratory of Pathology of the Cook County Hospital, and the Department of Pathology in the University of Illinois College of Medicine. A bacteriologic study of the prevailing epidemic especially among the civilian population forms basis of paper: "Among complications of the disease, 11 patients developed a unilateral or bilateral purulent otitis media. Pure cultures of pneumococci were isolated from 8 discharging ears, the hemolytic streptococcus in 2 patients, and the Streptococcus viridans in the remaining case. One child developed an acute and fatal mastoiditis. Purulent frontal sinusitis was encountered in one instance at necropsy, and cultures yielded pure hemolytic streptococci. It is to be expected that sequelæ of still more diverse nature may subsequently develop."

Strouse and Bloch, Michael Reese Hospital, Chicago: "Among initial symptoms are conjunctivitis, more or less severe coryza, headache, chilly sensations, and elevated temperature; a normal or slightly diminished systolic blood-pressure in those patients in whom the disease ran a moderate course; the diastolic pressure, however, was considerably lower than was to be expected. A systolic pressure of 100 with a diastolic pressure of 40 was not an uncommon occurrence. One patient whose systolic pressure was 120, diastolic 85, with Cheyne-Stokes breathing during the

pneumonic phase, had a systolic pressure of 180 and a diastolic of 115 on recovering from the pneumonia."

A. Francis Coutant, Chief Surgeon Hospital Ship, Manila: "During the month of June, 1918, an epidemic of influenza appeared in the Philippine Islands, which presented an interesting number of manifestations. About 300 cases, the majority of which were hospital patients, came directly under observation. The epidemic, so far as can be determined, began in Manila, although the fact that cases were first noted among longshoremen and other laborers along the water front might indicate that it has been brought in from some other part of the world. Within three days after the first cases were noticed between 70 and 80 per cent. of the longshoremen, clerks, and other workers at the docks were unable to work. In one large business firm 80 per cent. of the native employees were away from work for at least two days, while 50 per cent. of the Europeans were absent for one day. Within ten days after the initial outbreak the majority of those who had been ill were well enough to be back at work, and business and industrial activities resumed their normal course. However, the hospital continued to be overcrowded with cases diagnosed as influenza for two or three weeks more, and it was not until the advent of a typhoon, which brought with it a great deal of wind and rain, that the last vestiges of the disease were swept away. Frequent nausea and vomiting, and hemorrhage from mucous membranes were noted."

The following unpublished notes supplied by Major Hamburger, who was Chief of the Medical Service at Camp Zachary Taylor during the epidemic; and by Captain H. E. Happel, who was at Camp Sevier (though each is now at Camp Crane), are of special interest, reporting greater severity in nose, throat, and ear complications than from any published report I have seen.

Major Hamburger states that in the early stages of the epidemic there was almost always epistaxis, often profuse, and in the cases coming to autopsy in this stage there was practically always marked congestion of the sinuses. This was so constant that he regarded it as a part of the disease rather than a compli-

cation. Later in the disease, when the body reacts to the infection, this becomes a purulent sinusitis, not detected by the usual clinical symptoms, but found by close examination, suggested by the fact that cases coming to autopsy in this stage always showed purulent involvement of all the sinuses. He saw no cases of brain abscess or sinus thrombosis or purulent meningitis, although meningismus was noted in some cases. Otitis media was a late complication after the patient was convalescing from his bronchopneumonia. In the early days of the epidemic, he states, patients died in two or three days, consequently pus did not have time to form, but later in the epidemic the virulence became lessened and cases ran the entire course, with purulent otitis media and mastoid complications.

Captain Happel's report of conditions at Camp Sevier emphasized the frequency or almost constant purulent pan-sinusitis that was found postmortem in the early stages of the epidemic, and later observed in the living patients. He suggested that its earlier oversight might have been due to the fact that their chief attention was engrossed by the quickly developing and often fatal bronchopneumonia. He was transferred to another camp about the time the epidemic subsided, but up to that time very little otitis media had occurred, though recurrent suppuration from old lesions were noted. He emphasized the rarity of intracranial infections, and mentioned one patient who developed a left-sided hemiplegia and was trephined with the expectation of finding an abscess, but proved to be perfectly clean. At postmortem it was found that hemorrhage had occurred in the internal capsule, probably from septic embolus. There was pus in every sinus, in the mediastinum, and in both pleural cavities. Severe headache was a common early symptom.

Thus it seems evident to me, both from statistical reports and from our personal observations, for which every physician surely has had ample opportunity, that some interpretation other than the ordinary theory of contagion must be sought in order to explain the development, the universality, and the varying degrees of virulence of the recent and most terrible pandemic of modern, if not of all, time.

In the first place the onset of the disease was more variable than is usual in any known specific infection. Varying symptoms prevailed in different localities and in different individuals of any one locality. No specific organism has been detected common to all, but, instead, the usual group of bacteria common to infections of the respiratory tract, particularly the streptococcus, pneumococcus, staphylococcus, and the Pfeiffer bacillus of influenza, were found in varying orders of predominance. The most frequent and most serious complication was bronchopneumonia, which developed quickly and terminated quickly in the fatal cases, while those that lingered in most cases recovered, or else died of other complications. Sinus and aural complications were perhaps not more frequent, except in certain localities, than during occasional previous periods of markedly unfavorable atmospheric states when "colds," tonsillitis, laryngitis, or bronchitis prevailed to the point of being spoken of as "epidemic," and when present differed apparently but little, even in degree, from ordinary sinusitis and otitis media. Regarding these conditions as sequelæ it is, of course, too early to speak authoritatively, but it seems at the present time that the percentage is far below that of any previous epidemic of influenza. It is certainly true with respect to mastoiditis.

One important characteristic of the epidemic that was common to each locality was the precipitateness of invasion of the disease following a short interval, from one to several days, after the first cases made their appearance, seemingly a day upon which every influence favoring the development of the disease seemed to work in conjunction, so that it was not an unusual occurrence in large business establishments in some localities to find 50 per cent. or even more of the employees taken down, regardless of whether their occupations had kept them out-of-doors or indoors, and seemingly regardless of whether they had come in contact with anyone already infected. This was also just as true in sparsely populated country districts, where perhaps a whole family, entirely isolated, would be similarly seized. Many of those so affected, however, recovered in the course of three or four days sufficiently to return to work; and many died

within the same short space of time, while others developed various complications that ran a prolonged course, some of which proved fatal, though a higher percentage of the protracted cases recovered.

A fact which must not be overlooked is that during the period of the epidemic there were also numerous individuals who did not contract the so-called influenza, who suffered practically the same group of nose, throat, or ear discomforts lasting from a few hours to days or longer.

From my own observations, entirely in private practice, I have been unable to see that these phenomena of the upper respiratory tract, whether occurring in an individual whose illness was diagnosed as influenza or otherwise, differed materially from those that I have commonly observed under somewhat similar atmospheric conditions, except in point of degree.

Thus, are we to believe that the rhino-laryngo-otologic characteristics, observed in a measure universally, are a part of the disease, a predisposing or etiologic factor, a complication, or merely a coincidence? For my own part I believe that they are a part of the "disease," just as much a part as are any other phases connected with it. In other words, I am about persuaded that at the present time the most rational basis on which to explain the development and spread of the epidemic is that of a world-wide meteorologic disturbance, through the obscure influences of which all ordinary bacteria commonly present in the usual infections of the upper respiratory tract were rendered more highly virulent, while through the same influences normal human resistance to these organisms was diminished. Or, instead of these two influences working simultaneously, the meteorologic conditions might first work their effect upon the human tissues, so changing the chemistry of their secretion that there is developed a culture-media in which the bacteria, already present, are speedily propagated beyond the power of resistance, and the varying degrees of disintegration of the tissues ensue.

A seemingly trivial incident might be related in this connection illustrative of the physical effects of certain atmospheric

states on organic substances. Doubtless all, at least those who have lived in the country, are familiar with the commonly observed phenomenon of milk "turning" suddenly "sour" during the course of a summer thunder-shower, the popular supposition being that it is the thunder that works the change, when in reality electric phenomena that produce the lightning and the thunder in the atmospheric media is but the common force that effects the chemical change in the milk.

Now an interesting example of the principle from a recent personal experience might be timely in this connection, since I should like to obtain further evidence of its existence elsewhere. During the height of the epidemic my attention at home was called to the fact that the milk and cream seemed not up to the usual standard of freshness, and when no improvement resulted after several complaints (notwithstanding that the dairy from which it was delivered was undoubtedly one of the best in the city), our order was transferred to another dairy, with the result that their products showed the same defect as the first; then after a few days' trial another change was made, with what seemed at first but slight improvement, though followed by a gradual change for the better, till finally about two weeks from the time the first trouble occurred the milk and cream became again consistently good. It did not occur to me till three or four weeks later, however, on finding that many others had the same experience, that the incident might in any wise have been associated with the same disturbance of atmospheric elements which at the same time possibly was favoring the devastations then being wrought on human tissues through the medium of bacteriologic organisms and products rendered more highly virulent.

It should be noted that one of the most common and most active symptoms associated with the disease in this epidemic was toxemia.

I have emphasized on several occasions during the past year the toxic influence of diseased faucial tonsils, its marked inhibitory effect upon the hepatic function, with the resulting auto-intoxication and lowered blood-pressure, which, in turn, completes the circle by producing a low-grade congestion or intumescence of the

lining membrane of all the upper air passages and accessory cavities, thus perpetuating the most favorable enviroment in which bacteria, that same group which have been uniformly associated in the so-called influenza epidemic, can freely generate their varied cultural characteristics. I take it, then, as a self-evident conclusion, regardless of what may be the prime factor favoring the highest degree of susceptibility of any individual to the "influenzal" infection, that the existence of badly diseased tonsils implics at least an important accessory influence.

Having observed with great interest for many years, though for the most part unintelligibly, the marked influence of meteorologic states and changes or disturbances on mucous membranes of the upper respiratory tract, the nasal accessory and tympanic cavities, certain conditions seeming to favor the development and spread of infections, others producing simple irritations, etc., and I have been impressed in numerous instances throughout the course of the recent epidemic by the striking similarity of conditions, except in degree. And then when one takes into account the fact that there has been a worldwide abnormal meteorologic state throughout the past two or three years, according to government and other scientific reports (with which, however, I confess but limited acquaintance), it seems to me in nowise unreasonable to conclude that there was probably brought into action such combined disturbances—atmospheric, electric, chemic, whatever it may be—as would so increase the virulence of bacterial organisms and so reduce the properties of human resistance that the pandemic was made possible.

To summarize briefly: considering the various phenomena observed during the recent epidemic in those who suffered the most virulent infections, and in others who, during the same period, exhibited characteristics similar in most respects, though milder in degree; the precipitate character of the epidemic's invasion in each locality, apparently precluding the possibility in numerous instances of contagion through personal contact one with another; the presence of all the usual bacteria common in normal times to infections of the upper respiratory tract, and the variableness of the predominant organism, not only in different

localities but in different individuals; the fact that meteorologic conditions over practically the whole earth have shown unusual disturbances during the past two or three years, and particularly during the past year; and that all of these seem to be so intimately associated, meteorologic influences may have played an important rôle as a causative factor in the great pandemic, and deserving of more careful consideration and investigation.

CLINIC OF DR. MAURICE OSTHEIMER

University Hospital

INFLUENZA IN CHILDREN

The most striking fact in the recent epidemic of influenza, in so far as it concerned children, was the uniform drowsiness, even stupor, observed in every instance. Even before taking the child's temperature the mother or the nurse noticed not only the flush due to the fever but also a marked drowsiness, almost a "doped" condition, in practically every case. Upon entering the hospital ward in which these cases were treated it was not difficult to pick out new cases of influenza, since these children lay quietly, often with their bottles but half full, apparently objecting to disturbance of any kind. In the uncomplicated cases the drowsiness and fever persisted for three to five days, usually less than a week, with some cough developing during this time in more than half of the children.

It fell to my lot to observe about 80 such children; in 48 of these only were there sufficient data for tabulation. This included 8 patients who were under treatment in the Children's Ward of the University Hospital, 3 of whom died of bronchopneumonia. These were the only fatalities among the 80 cases, a mortality rate of about 4 per cent. For the privilege of reporting these cases my thanks are due to Dr. J. P. Crozer Griffith and Dr. Howard Childs Carpenter.

A study of these 48 cases (Table I) shows that the sexes were almost equally divided, 25 girls and 23 boys, as was to be expected in an epidemic which was so wide-spread. Their ages varied from three months to twelve years (Table II). There were 18 under two years of age; 13 between two and five years; and 17 from six to twelve years of age. The highest temperature re-

TABLE I.—INFLUENZA CASES

	Sex.	Age.	Highest temperature, degrees F.	Duration of fever, days.	Drowsiness.	Loss of appetite.	Bronchitis.	Constipation.	Vomiting.	Pneumonia.	Aches and pains.	Abdominal tenderness.	Sore throat.	Termination.	Complications.
1	M.	3m.	101	3	+	+	+	+	+	−	−	−	−	R.	
2	F.	7m.	102	3	+	+	−	−	−	−	−	−	−	R.	
3	F.	9m.	102	3	+	+	−	+	−	−	−	−	−	R.	
4	F.	18m.	103	5	+	+	+	−	+	−	−	−	−	R.	
5	M.	3y.	102	3	+	−	−	−	−	−	−	−	−	R.	
6	F.	6y.	101	3	+	+	+	−	−	−	−	−	+	R.	Cervical abscess.
7	F.	7y.	100	5	+	−	+	+	−	−	+	−	−	R.	
8	F.	3y.	103	3	+	+	+	−	−	−	−	−	−	R.	
9	F.	6m.	104	28	+	+	−	+	+	+	−	−	−	R.	
10	F.	11y.	102	3	+	−	+	−	−	−	+	−	−	R.	
11	F.	3y.	101	3	+	−	+	−	−	−	−	−	−	R.	
12	M.	5y.	104	8	+	+	+	+	+	−	−	+	−	R.	Epistaxis.
13	M.	7y.	103	5	+	−	+	−	−	−	+	−	+	R.	
14	M.	12y.	102	3	+	+	+	+	−	−	+	−	−	R.	Persistent sore throat.
15	M.	12y.	104	5	+	−	+	−	−	−	+	−	+	R.	
16	F.	2y.	104	8	+	+	−	−	−	+	−	−	−	R.	
17	M.	6y.	103	9	+	−	+	+	−	−	+	+	−	R.	
18	F.	7y.	104	7	+	−	+	+	+	−	+	−	−	R.	
19	M.	8y.	103	6	+	−	+	+	+	−	+	−	+	R.	
20	M.	8y.	105	8	+	−	+	−	−	−	−	−	−	R.	
21	F.	2y.	105	8	+	+	+	+	−	−	−	−	−	R.	
22	F.	7y.	102	18	+	−	−	+	+	+	−	+	−	R.	
23	F.	4y.	104	10	+	+	−	+	−	+	−	−	−	D.	

24	F.	6m.	102	24	+	+	−	+	+	+	−	−	−	R.	Convulsions.
25	F.	18m.	103	7	+	+	+	+	+	−	−	−	−	D.	
26	F.	11m.	102	19	+	+	−	+	+	+	−	−	−	R.	
27	M.	3y.	105	13	+	+	−	+	+	+	−	−	−	D.	
28	F.	6m.	104	18	+	+	−	−	−	+	−	−	−	R.	
29	M.	15m.	102	4	+	+	−	−	−	−	−	−	−	R.	
30	F.	10y.	103	6	+	−	+	+	−	−	+	−	−	R.	
31	M.	20m.	104	9	+	+	+	−	−	−	−	−	−	R.	
32	F.	7y.	102	10	+	−	+	−	−	−	+	−	−	R.	
33	F.	4y.	101	3	+	+	+	−	−	−	−	−	−	R.	
34	M.	20m.	104	18	+	+	−	+	+	+	−	+	−	R.	Scarlet rash limited to trunk.
35	F.	4y.	105	10	+	+	−	−	−	+	−	−	−	R.	
36	M.	3y.	102	3	+	+	+	−	−	−	−	−	−	R.	
37	M.	18m.	101	3	+	+	−	+	+	−	−	−	−	R.	
38	M.	6y.	104	4	+	+	+	−	−	−	+	−	+	R.	Persistent asthma.
39	M.	8y.	102	3	+	−	+	+	−	−	+	−	−	R.	
40	M.	3y.	102	3	+	−	+	−	−	−	−	−	−	R.	
41	F.	18m.	102	3	+	+	+	−	+	−	−	−	−	R.	
42	M.	9m.	101	3	+	+	+	−	−	−	−	−	−	R.	
43	F.	3m.	101	5	+	+	+	−	+	−	−	−	−	R.	
44	M.	6y.	104	14	+	+	−	−	−	+	−	+	+	R.	
45	F.	4y.	103	8	+	+	−	−	−	+	−	+	−	R.	
46	M.	10m.	104	16	+	+	−	+	+	+	−	−	−	R.	
47	M.	10y.	103	16	+	+	−	+	+	+	+	+	+	R.	
48	M.	9m.	103	5	+	+	+	+	−	−	−	−	−	R.	
	25 M. 23 F.	..	..	..	48	33	29	23	17	14	13	7	7	3 D. 45 R.	

corded varied from 100° to 105° F. (Table III). The number of days which the fever lasted also varied (Table IV). In sixteen cases, 33 per cent., the fever was present only three days; and in

TABLE II.—AGES

Months.	Cases.	
3	2	18 cases under two years.
6	3	
7	1	
9	3	
10	1	
11	1	
15	1	
18	4	
20	2	

Years.	Cases.	
2	2	13 cases between two and five years.
3	6	
4	4	
5	1	
6	4	17 cases from six to twelve years.
7	5	
8	3	
9	0	
10	2	
11	1	
12	2	

24 cases, 50 per cent,, it lasted three to five days. Bronchitis and bronchopneumonia occurred in 43 cases, 89 per cent.; pneumonia, in 14 cases, 3 per cent. (with the 3 deaths already noted, a mortality of 21 per cent.); and bronchitis, in 29 cases, 60 per cent.

TABLE III.—HIGHEST TEMPERATURES

Fahr.		
100°	in	1 case.
101°	in	7 cases
102°	in	14 "
103°	in	10 "
104°	in	12 "
105°	in	4 "

The two common symptoms noted in every case, regardless of age, were the fever and the marked drowsiness, almost a stupor

in some cases, present even in the infants of three months. The symptom next most common was loss of appetite, noted in 33 children, 69 per cent. This symptom varied markedly among the children; some of the older children continued to eat well in spite of the evidences of toxemia. Other symptoms noted were constipation in 23 children, 48 per cent.; and vomiting in 17 children, 35 per cent. The aches and pains so commonly described by adults with influenza were present in only 13 children, 27 per cent., among the larger children, as was to be expected. Abdominal tenderness was noticed in 7 children only, 15 per

TABLE IV.—DURATION OF FEVER

		Pneumonia.	Death.
3 days	in 16 cases	—	—
4 "	2 "	—	—
5 "	6 "	—	—
6 "	2 "	—	—
7 "	2 "	—	—
8 "	5 "	2	—
9 "	2 "	—	—
10 "	3 "	2	—
13 "	1 case	1	—
14 "	1 "	1	—
16 "	2 cases	2	—
18 "	3 "	3	1
19 "	1 case	1	1
24 "	1 "	1	1
28 "	1 "	1	—
	—	—	—
	48	14	3

cent. Sore throat also was a complaint in 7 of the children, 15 per cent. The complications which occurred were severe epistaxis, severe and persistent sore throat, convulsions, asthma with persistent cough, cervical abscess, and a scarlatiniform eruption limited to the trunk, noted in one case each.

There were but 3 deaths, and these were due to bronchopneumonia, as already stated. Almost every child affected by influenza lived in a family in which other cases of influenza had already developed. Most of the infants showed, besides the drowsiness and the fever, a distinct inclination to lie quietly, sleeping most of the time, without caring for much food. A few

ounces from each bottle, or even less at times, sufficed. But all the children, even the infants, took water freely.

The routine treatment consisted of plenty of air, even keeping the child out of doors on sunny days, and always keeping windows widely open. On cool or damp days enough covers were used to prevent chilling the patient. A few children really needed hot-water bags under the covers; but the great majority did well in the cold air, without extra warmth. Drinking water was encouraged; a half cup to a whole glass of water was often given every hour or every two hours; to infants frequently in the bottle.

The only drug used was magnesium sulphate, in doses varying from 1 to 4 level teaspoonfuls, diluted in 3, 4, or 5 teaspoonfuls of water, given every morning, as long as the fever lasted. To those few children in whom vomiting occurred lime- and cinnamon-water, half and half of each, were given, in teaspoonful doses every half-hour, for eight or ten doses; followed by the salts, or by citrate of magnesia in doses of ½ glass, repeated in three or four hours when necessary. For the hard cough so common at the onset of the bronchitis or pneumonia 5 drops of syrup or wine of ipecac were given every two hours, in 2 teaspoonfuls of water, for five or six doses, until the cough became looser. Just as soon as the fever reached 99° F. or less a strong bitter tonic was begun, such as tincture of nux vomica, 5 to 7 drops; bicarbonate of soda, 5 to 7 grains; compound tincture of gentian, 20 drops, with enough water to make a teaspoonful, given before each meal. When the cough persisted, with expectoration, syrup of the iodid of iron, ½ teaspoonful well diluted in ¼ glass of water, was kept up after meals, for some weeks.

While it was difficult to keep some of these children quietly in bed after the fever had disappeared, efforts were made to keep them in bed, allowing them to sit up in bed once daily for a short time, supported by pillows at first; later, twice a day; then without the pillows; and then only to try sitting up in a chair until tired. Thus convalescence was allowed to proceed very gradually, because a few of the earliest cases came down with a relapse after being up too soon, or after moving about and doing

too much the first day they got out of bed. Most of these children did not go about until the second week, and some not until the third week.

The coal-tar products and Dover's powder, etc., used at first, proved to be quite unnecessary, as so many of our physicians found true among adults also. Far better and quicker results were achieved without their use, especially among children, who respond so rapidly to even the slightest depressive action. Whisky, given occasionally before the doctor arrived, was found commonly to disagree with the child; several times vomiting and decided indigestion resulted from the whisky given before the physican reached the child.

CLINIC OF DR. THOMAS McCRAE

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SCIATICA[1]

THE most common complaint with which patients come to us is pain or discomfort. We all recognize that this is not a disease, and that our efforts must be directed to determining the cause of the pain. We should never regard a diagnosis of pain alone as being a proper one. For example, to make a diagnosis of "headache" is evidently not even an approach to a proper understanding of the essential disorder. Yet, in the condition termed "sciatica" we too often rest satisfied with this diagnosis alone. A study of some of the patients to be shown should convince you that this is, in some instances at any rate, only scratching the surface.

There is one lesson difficult to learn, and when learned often forgotten, which is, that the seat of complaint of pain by the patient and the situation of the disease causing the pain are often distant from each other. Many examples will occur to you at once: A child with hip-joint disease complains of pain in the knee, a man with chronic appendicitis has gastric symptoms, prostatitis causes pain referred to the kidney, and so on. Therefore, when a patient comes complaining of pain it is wise to remember that the cause may be elsewhere. As you go on in medicine you will see many examples of the errors due to this fact being forgotten. This does not mean that it is not important to determine whether the pain has a local cause. It is wise to determine this early in the examination.

When pain is due to disease elsewhere there must be some association between the part where the pain is felt and its real

[1] This represents a combination of material from several clinics at the Jefferson and Pennsylvania Hospitals.

but distantly situated cause. This applies particularly to pain which is felt on the surface of the body. If you know anatomy thoroughly it is easier for you to trace the possible associations and hence determine the possible causes. If you do not know your anatomy, it will be a hopeless puzzle. This is another proof of the value of learning anatomy thoroughly. It would be well if this could be emphasized in the mind of the student when he is studying anatomy.

It is natural that pain referred to definite nerves should often be wrongly interpreted. The pain is so definite in its situation that a local condition in the nerve itself seems almost inevitable. Of course, there may be some change in the nerve, but this is not necessarily a primary process there. The condition known as sciatica illustrates this particularly well. The word is used to designate pain referred to the sciatic nerve. As an example of terms which mean nothing you will sometimes hear the expression "sciatic rheumatism" employed. This has nothing to do with rheumatic fever, but is an illustration of the use of the word "rheumatism" as meaning pain.

Let us go over the history and examine the first patient.

History.—CASE I.—P. J., aged forty-one, was admitted to the Pennsylvania Hospital on November 11, 1918, complaining of pain in the right hip, extending down the leg, and in the back.

Past History.—He had typhoid fever many years ago and this was the only acute illness he has had. There is no history of cough or shortness of breath. His appetite and digestion have been good; the bowels are regular and there is no history of any urinary trouble. The patient has three children, all of whom are well, and his wife has not had any miscarriages. There is an indefinite history of a luetic infection many years ago. He has used alcohol moderately.

Present Illness.—This began in the winter of 1917–18, but the exact date he cannot give. He states that he began to suffer with pain in the region of the right hip-joint, which gradually extended down the leg. The pain has grown worse, and in the last few weeks it has become practically continuous day and night. He has not been able to use the right leg and the pain has

interfered markedly with his sleeping. There has also been pain in the lower right back in the lumbar and sacral regions, but this has been less severe than the pain in the leg. As a result he has been much upset generally and has lost some weight.

Examination.—The temperature, pulse, and respirations are normal. The examination of the head, thorax, and abdomen shows nothing abnormal except chronic disease of the tonsils. There is no leukocytosis and the urine is clear. Rectal examination is negative. The left leg is perfectly normal. You can see that the right leg shows a great deal of discoloration from counter-irritation and many scars from wet cupping and the use of the cautery. He complains of pain throughout the whole leg, and on handling and movement the leg is painful everywhere. The patient indicates the most severe pain as situated over the sciatic notch and running down the back of the thigh. Below the knee he states that it is most severe over the anterior external surface of the leg and the dorsum of the foot. He keeps the right leg more or less in the position of flexion and slight abduction. There is no evidence of disturbance of the hip-joint. The thigh can be flexed on the body as long as the leg is flexed at the knee. If any attempt is made to extend the leg there is severe pain, as is very evident. There is more or less general tenderness over all the leg except on the front of the thigh. The special points of tenderness on pressure are over the sciatic notch, in the middle of the popliteal space, and opposite the head of the fibula. There is also very severe pain on pressure along the course of the anterior tibial nerve. The leg reflexes at present are, if anything, rather exaggerated. You can see that the tendo achillis reflex is well marked. There does not seem to be any marked disturbance of the sense of touch except that he is rather confused in distinguishing between a sharp and a dull object. There also seems to be some confusion in regard to the sensations of heat and cold. This is most marked over the dorsum of the foot and the outer side of the leg below the knee.

There is no doubt of the fact that the patient has severe

pain referred to the course of the sciatic nerve, and to this we give the name sciatica. Should we rest content with this as a diagnosis? Most certainly not, for this would be equivalent to a diagnosis of a symptom and not of a disease. Sometimes we have to rest content with such a diagnosis, but we should always regard it as a reflection on ourselves and leave nothing undone to get at the cause. As long as we are not satisfied with a diagnosis and have some "intelligent curiosity" to go deeper there is hope of learning the truth. Let me impress on you the point that in the great majority of cases termed "sciatica" we are dealing with a symptom of disease elsewhere. Do not accept this because I say so, but make up your minds from the evidence presented in the patients brought before you and those under your care after you graduate. In saying this do not understand me as expressing the opinion that there is no change in the sciatic nerve. There may be definite changes of an inflammatory nature. The important point to learn is that these are rarely primary. You may ask where the line is to be drawn in excluding some grade, perhaps slight, of neuritis. For practical purposes you do not need to draw any line. In fact, there are transition forms between what may be called a neuritis and a neuralgia.

It is possible that this patient may be one of the rare examples of a true neuritis of the sciatic nerve. If this is the case we would expect to find a definite change in the reflexes, particularly in the tendo achillis reflex, which would be diminished or absent. In this patient you note that this reflex is increased. A marked grade of muscular atrophy or alteration in the electric reactions would also be in favor of a true neuritis.

Therefore we conclude that we are not dealing with a true neuritis, but with a condition in which a painful sciatic nerve is due to disease elsewhere. The scars over the course of the nerve are good evidence of the thoroughness with which local treatment in the form of counterirritation has been employed. Had the cause of the pain been in the nerve we should have expected some improvement, but the patient is very emphatic in his statement that any benefit was slight and only temporary.

He is the one who should know. Our next effort must be directed to deciding what and where this disease process is. If you will consider the anatomy of the sciatic nerve it may help us to state the possibilities. It is evident that there are many chances of the nerve being affected by disease elsewhere. Let us study some of these in the patient. We have already found that there is no evidence of any disease of the hip-joint. Examination of the sacro-iliac joints does not show anything to suggest disease there. Examination of the prostate is negative. One point in the history should suggest a possibility to us. He complains of pain in the lower back on the right side. This always demands a careful study of the spine.

When the patient stands, the examination of the spine shows signs of some change there. The muscles on the right side of the spine in the lumbar region are seen to stand out more prominently, and on palpation they are felt to be much more firmly contracted than on the other side. On testing the movements of the spine you can see that they are much decreased in certain directions. Movement is much restricted on bending forward, backward, and to the right. He has more movement on bending to the left. This is suggestive of some disease in the spine and is confirmed by the *x*-ray examination, the report of which is as follows: "There is no lesion found in the sacro-iliac regions. There are some areas of calcification, apparently united to the upper border of the third and fourth lumbar vertebræ on the right side; in each case extending upward and nearly meeting the lower border of the body above. Apparently a case of hypertrophic spondylitis" (Fig. 141).

With spondylitis it is common to find pain referred to the nerves which may be affected by the process. This may be by pressure or communicated inflammation. Therefore it would seem reasonable to conclude that in this patient the process in the lower spine is responsible for the sciatica.

Should we stop there? We have made an *anatomical* diagnosis of spondylitis, but it is evident that we should try and go further and determine the *etiology* of this if possible. In this let me suggest one disease to be excluded in such cases—*syphilis*. It is

a good rule to exclude syphilis in every obscure case of sciatica and perhaps also in cases that do not seem obscure. Syphilitic disease of the bones of the spine in the form of arthritis is not

Fig. 141.—The *x*-ray picture of the lower spine (Case I).

very rare. In this case there are no signs of syphilis and the Wassermann reaction is negative. Excluding this, we regard such a process in the spine as a form of arthritis deformans and

due to a focus of infection somewhere. The routine examination shows marked infection of the tonsils, and it seems a fair inference that his arthritis is due to this. (Later the tonsils were removed and pus was found in both of them.)

Let us go over our diagnosis again in its details:

1. We found a painful sciatic nerve, the condition known as sciatica or, as it is sometimes termed, "sciatic neuralgia."

2. Next we find a spondylitis, to which we regard the sciatica as secondary.

3. In the search for the cause of the spondylitis we find infection in both tonsils.

In the order of events we should say (1) chronic tonsillitis, (2) spondylitis with new bone formation and undobutedly some inflammation of the soft structures, and (3) sciatica. It is quite evident that had we been content with the diagnosis of sciatica the real disease would not have been recognized. The bearing of this on treatment is evident.

The next case illustrates other possibilities in the search for the cause of the sciatica.

CASE II.—This patient is a male, aged forty-seven, who has a negative past history. He has always been active and has taken a great deal of exercise. There is no history of gonorrhea or lues.

Present Illness.—The onset of his trouble was about one year ago, when he had a fairly sharp attack of pain which began suddenly in the region of the right sciatic nerve. He kept about at first, but in three days he was compelled to go to bed, where he remained for a week. He then got up, but has had some trouble in the same region ever since. His work compels him to stand a good deal, and this usually aggravates the pain. In addition, he states that there has been a certain amount of numbness in the right foot. About a month ago he had what he terms a "lame back." This troubled him a good deal, particularly in stooping, but did not compel him to go to bed. Two weeks ago there was a very sudden return of the sciatica in such a severe form that it has been difficult for him to get about, as any attempt to walk causes severe distress. He has had a great deal of pain at night. On

questioning him carefully regarding the pain in the back, which he terms "lumbago," he tells us that he has had it a number of times, the first attack being perhaps twenty years ago. He states that it has never been severe enough to compel him to go to bed.

Let me digress for a few minutes to discuss the significance of this part of the history. The term "lumbago" is loosely used, and is generally employed to designate pain in the lower back. We should never be content to make such a diagnosis. It would be better to term it "pain in the back" rather than lumbago, because when you have given a name to anything you have to some extent disposed of it. Look on lumbago merely as a symptom and not as a disease, and do not rest until you have discovered what is causing the pain.

Examination.—You can see that the patient looks very well nourished and has a good color. There is no evidence of disease in the thoracic or abdominal viscera. He does not seem to have any particular difficulty in sitting down or getting up from the sitting position, but you observe that he becomes uneasy if he is kept standing for more than a short time and complains of pain which he refers to the region of the right sciatic nerve. He has severe pain when an attempt is made to flex the thigh on the trunk with the leg extended. On testing the movements there is no restriction at the right hip-joint, but on flexing the thigh to about right angles with the trunk a very definite click is heard, apparently in the region of the right sacro-iliac joint. Pressure over this joint does not seem to cause any discomfort. Forcible extension of the right thigh on the trunk causes severe pain referred to the sacro-iliac joint.

This seems to suggest very definitely some disease in the sacro-iliac joint. There are two methods by which we may be more certain about this. One is by an *x*-ray study and the other by the result of fixation of the joint. The report of the *x*-ray study by Dr. Manges is as follows: "There is apparently absorption of the cartilage in the sacro-iliac joint, so that bone approximates bone, especially in the upper half of the joint surface. There is no evidence of any disease in the lumbar vertebræ."

On rectal examination it was found that the prostate was considerably enlarged and somewhat tender. This naturally brought up the question as to whether the sciatica might not represent a reflex pain from the prostatitis. The therapeutic test was of considerable help in deciding this point. We fixed the sacro-iliac joint as far as possible by strapping and secured a very striking result. The patient states that within two days there was very marked relief and within a few days after this the pain had entirely disappeared. We kept up a certain amount of fixation of the sacro-iliac joint and as long as this was done the patient was comfortable. This result seemed to definitely exclude the possibility that the pain might have been referred from the prostate. We have given him directions to be very careful to avoid any sudden lifting or any movement which might strain the joint.

This brings before us an entirely different etiology for sciatica. In the previous case we tried to carry the etiology farther back than the anatomical lesion. Can we do so here? You remember that in his history he stated that there had been attacks of pain in the back at intervals for twenty years. Has this been due to the lesion in the sacro-iliac joint? It may be so, but other causes have to be considered. One of these is spondylitis, but if he had this for such a long period of years we would expect to find some changes in the bones. The *x*-ray report excludes these. A second possibility is that the prostatitis may be the cause. It is difficult to exclude this, but we would expect more symptoms to have appeared by this time if the prostatitis is of such long duration. He has no symptoms of a urinary or sexual character and, therefore, I am inclined to the view that the sacro-iliac trouble has been responsible. If so, the cause may have been an injury of the joint through some sudden strain. A process of infection may be responsible, but he does not show any evidence of this unless it be in the prostate.

It is not difficult to understand why disease of the sacro-iliac joint causes pain referred to the course of the sciatic nerve. The lumbosacral nerve passes over it and hence is easily affected by disease of the joint.

The next patient shows the same condition of sciatica, but with some additional features and another cause.

CASE III.—The patient, aged fifty-two, occupation farmer, comes complaining of pain associated with disturbed sensations in the left leg.

Past History.—The only acute disease was an attack of dysentery in youth. His appetite and digestion have been good, and the bowels regular. He has used tobacco heavily and alcohol moderately. There is no history of gonorrhea or lues. For some time past he has been troubled by urinary symptoms and has had a certain amount of difficulty in urinating, but this has never been very serious.

Present Illness.—The exact time of onset is difficult to determine, but the symptoms probably have been present for about three years. He first noticed a disturbed sensation, particularly in the lower left leg. This he describes as a burning sensation. Some time afterward he began to have pain in the lower left leg on walking or standing. He does not give a very definite account of the location of this in the early months, but it gradually extended higher up until for a year past it has been referred to the course of the sciatic nerve. At the same time that he has the feeling of pain he also has a sensation as if the whole leg was "dead." This disturbed sensation is more marked over the thigh than below the knee. He sticks to his description of severe pain and a sensation of "deadness," as he describes it, as coexisting in the leg. He also feels that there is some loss of power in the left leg, but he has always been able to get about, and has never had to go to bed with the condition. He has some difficulty in balancing on the left leg and states that he feels that it is "unreliable." The condition has disturbed him a good deal and has interfered with his sleep. As a result of this he has lost about 30 pounds.

Examination.—The patient's general condition is good and nothing abnormal is found about the head, the chest, or abdomen. The prostate is found to be considerably enlarged, very tender, and the secretion contains a large number of pus cells.

On walking, the patient shows some slight difference in the

action of the two legs. This is more marked when he attempts to walk upstairs. There is a slight difference in the size of the legs, the left being the smaller. The knee-jerks and tendo achillis reflexes are well marked and equal on the two sides. It is not possible to determine any definite alteration in sensation even over the areas where this is most marked according to his account.

Examination is absolutely negative with reference to any other cause for the sciatica. There is no evidence of any disease of the bones, of the spine or pelvis, or of the sacro-iliac and hip-joints by ordinary examination and by *x*-ray studies. The disease of the prostate seems to be the only explanation. Treatment for this was begun promptly, and the patient thinks that his condition is improving, but as yet not sufficient time has elapsed to give any opinion regarding the ultimate outcome.

One feature in the history deserves emphasis, and this is the fact that the various sensory disturbances antedated the appearance of the pain in the sciatic nerve. It is also worth noting that these sensory disturbances are entirely subjective. We are not able to find any evidence of disturbed sensation by the usual tests.

In this case the only etiologic factor which we can find is the chronic prostatitis. You note in the history that he had a good deal of indefinite sensory disturbance for some time before the onset of the sciatica. The pain has apparently not been as severe in this patient as in the two preceding patients. It has seemed to me that this is true in the cases of sciatica secondary to prostatic disease that I have seen. The cause of pain referred to the sciatic nerve may be (1) from pressure on the nerve, especially seen in some cases of carcinoma of the prostate, and (2) from the association of the roots of the pudic nerve with the sacral plexus.

Discussion.—You may ask very properly as to the relative frequency of these causes. A most interesting study by Rogers[1] is worth quoting in this connection. He studied a series of 50 cases. In 49 there was a lesion of the lower spine, lumbo-

[1] Jour. Amer. Med. Assoc., 1917, lxviii, 425.

sacral, or sacro-iliac joints, in 1 there was carcinoma of the prostate; 8 of the cases had vertebral arthritis and 4 had tuberculous disease. In this series disease of the sacro-iliac joint was the most frequent cause, and Rogers gives the excellent suggestion that the pain produced by the endeavor to flex the straight leg on the trunk is not due to stretching of the sciatic nerve, but to the condition in the sacro-iliac joint. This is a point well worth having in mind in the study of your patients.

There is also the question as to how often the pain is due to a true sciatic neuritis. Judging from my own experience I should say extremely rarely. The more thoroughly you study your patients, the rarer such cases will be, and the chances are that many of you will never see one. You will see the statement that sciatica occurs in diabetes mellitus and gout. This cannot be denied, but the cases occurring in diabetes must be very rare. If it occurs in a patient said to have gout, make a very careful study to be sure that you are not dealing with arthritis deformans, possibly with spondylitis. As to the explanation that sciatica is due to the so-called "rheumatic diathesis," do not give it a place in your memories. The term has no definite meaning and usually covers ignorance. It sounds plausible, but may be dismissed.

Other Causes.—There are additional causes of sciatica which should be kept in mind. They are rarer than those demonstrated in these patients.

(1) *Hip-joint Disease.*—This should not cause difficulty if a proper examination of the joint is made. The use of the *x*-rays is of great value in recognizing it.

(2) *Lesion of the Cauda Equina.*—The signs of this vary with the extent of the process, but unless the lesion is low there will be paralysis, and in all cases there is likely to be an area of anesthesia. The sensory and motor symptoms are distributed in root areas and not according to the peripheral nerves. Examination of the condition of the sphincters of the bladder and rectum is important.

(3) *New growth* or *tuberculosis* of the bones of the lower spine or pelvis. These may cause symptoms like those produced

by changes in the bones due to arthritis. The *x*-ray examination should give definite information.

(4) *Varicose or Phlebogenic Sciatica.*—This is a very rare form, but with features which enable it to be recognized quite readily if you know about it—which is true of many things in medicine. There is severe pain referred to the sciatic nerve, sometimes accompanied by painful cramps in the gluteal muscles. When the patient stands or walks slowly the pain is severe, and is usually most marked in the popliteal space and below the head of the fibula. When he lies down or exercises the legs vigorously the pain disappears. Examination with the patient lying down may not show any abnormality, but there is pain and tenderness when he is examined in a standing posture. This form is due to varicose veins within the sheath of the sciatic nerve. Occasionally there is varicosity of the superficial veins and slight puffiness in the popliteal space with it. The treatment is mechanical by the use of an elastic support.

(5) *Pelvic Disease.*—It can be readily understood that any condition in the pelvis which causes pressure on the nerve may give rise to sciatica. It has resulted in parturition from the pressure of the child's head. Pressure from a mass due to pelvic inflammatory disease or from a malignant growth may be responsible. Hence the necessity of always making a rectal examination and a vaginal examination in women.

(6) *Psoas abscess* is a rare cause.

(7) *Syphilis.*—This should be considered in every obscure case. Some writers have discussed it as a primary syphilitic neuritis, and this is possible in the form of a sclerogummatous neuritis. But before accepting such a diagnosis careful study should be made to exclude other possibilities, not forgetting that syphilis often causes spondylitis. A syphilitic meningitis or periostitis may be responsible. In going over some of the reports in the literature of cases regarded as syphilitic one is impressed by the absence of any records which point to a proper study of the spinal and pelvic bones and joints. There do not seem to be any features by which we can recognize a sciatica due to syphilis other than by the serologic and therapeutic tests.

Some place emphasis on the pain being particularly severe at night, but this is true of many cases which are certainly not due to lues.

(8) *Gonorrheal Sciatica.*—This is described in the literature, but must be very rare. One would suspect that in such cases there had been an arthritis to which the sciatica was secondary.

Diagnosis.—It may be said that in the great majority of cases the recognition of sciatica is not difficult. The features are usually quite characteristic. The next step is to decide whether the pain is due to a true neuritis or to a neuralgic sciatica. The former is extremely rare, and the important points have been mentioned. Observation of the tendo achillis reflex is especially important in this. With a sciatic neuralgia the next step is to decide as to the cause. This involves a thorough study of the lower spine, the pelvic joints and bones, and the pelvic organs. Determine first if there is any evidence of disease of the lower spine, then examine the sacro-iliac joint and the hip-joint. In studying these areas the information from the *x*-ray plates is of the greatest aid. Then examine the pelvis with reference to its organs. If no evidence of disease is found in any, then consider the rarer causes mentioned above, not forgetting syphilis.

Further, we should make the effort to go still farther back and determine the cause of the lesion. This applies especially to arthritis of the spine as was shown in Case I. I should not like you to go away with the idea that the diagnosis of the cause is always as easy as it has been in these patients. That would be too much to expect, and you will have patients in whom the cause is very obscure and in whom the search seems hopeless. Still something is gained if you recognize this and feel that the cause is still to be found. This is better than going no farther than making a diagnosis of sciatica only.

The errors that are made in the recognition of sciatica are usually due to a careless examination. In some cases the pains of tabes have been regarded as those of sciatica. Osteomyelitis has caused pain which has led to a mistaken diagnosis. The pain due to flat-foot or varicose veins should not cause error.

In one case known to me the pain associated with intermittent claudication had been regarded as sciatica. Anatomic abnormalities in the lower vertebræ and especially in the transverse processes may cause pain which simulates sciatica.

Prognosis.—The same warning may be given here. Do not expect to secure in every case as rapid results as are shown in Cases I and II. If you do, some sad disappointments are in store for you. The first patient entered the hospital almost unable to get about and having constant severe pain except when under the influence of sedatives. Within a week he was much improved and within three weeks was waiting on the other patients as a volunteer orderly. The second patient had relief in two days and within a week stated that he was perfectly well. He was free of pain, but the lesion in the sacro-iliac joint was still present.

It is evident that the prognosis depends very largely on your ability to influence the cause. But two of the common causes—spondylitis and sacro-iliac joint disease—are often very difficult to influence, and hence the need for caution. We are fortunate in these patients, but the next one may be more difficult to help. Therefore, always be guarded and explain to the patient that the outlook may depend on factors which are sometimes difficult to remedy. Your knowledge of the etiology is of great value in prognosis and treatment, but it also aids you to realize that the course may be protracted. It explains the cases of chronic sciatica in which the pain recurs over long periods. The other pains due to spondylitis and sacro-iliac joint disease have the same character. However, it is fair to say that in general an exact diagnosis is of help in prognosis—whether this be favorable or unfavorable as regards the probable duration of the pain.

Treatment.—It is evident that no proper treatment can be given for sciatica which is not based on an etiologic diagnosis. To relieve the symptom of pain is essential, and to this extent a symptomatic treatment is proper. The management of the cause will be very different, as is shown by the patients you have seen. In one, fixation of the spine with removal of the infected tonsils; in the second, fixation of the sacro-iliac joint; in the third, treatment of the prostatitis was required. The man who

insists on proper diagnosis as an essential for proper treatment is often termed a "therapeutic nihilist," exactly why it is difficult to discover. But surely this probalem of sciatica illustrates the importance of proper diagnosis. There are articles on the treatment of sciatica in which there is not a word of reference to the etiology and to the need of attending to the cause. They deal only with the relief of pain.

However, in the majority of cases it is necessary to relieve the pain. The first essential in this is *rest.* Let it be emphasized that this should be complete and for some time, the duration to be determined by the progress. The patient should be in bed and move as little as possible. He should not get up to go to stool, but use the bed-pan. Every effort should be made to secure comfort. Sometimes a splint for the leg is advisable, but usually proper support in the easiest position can be secured by pillows. If there is disease of the spine, it may be well to see that the back is properly supported. If there is marked improvement in a short time, as often happens, you may have trouble in keeping the patient quiet. Warning them that an hour up and about may undo the effect of a week's rest may have some effect. The length of the period of rest has to depend somewhat on how successful you are in discovering and treating the cause. Thus in the second case the period of rest was only two days and the patient was going about within a week. Such a result is exceptional. If you cannot find any cause, rest for some weeks is usually indicated.

There are a number of drugs which may be given for the relief of the pain. The salicylates are generally of value, and my preference is for the sodium salicylate in doses of 15 grains four times a day. The dosage may soon be reduced if the result is satisfactory. It is often of advantage to combine sodium bromid (10 grains) with the salicylate. Acetyl-salicylic acid may be given up to 30 or 40 grains a day for a short period. The combination of phenacetin and salol (5 grains each) three times a day is sometimes useful. Other drugs of the coal-tar class may be given, and sometimes a combination of small doses of several of them is more effectual than a larger dose of one. It is well to try and avoid the use of opium or its derivatives. Morphin

should be given only if other measures fail to give relief and the pain is very severe. Its administration should not be left to the patient or to a member of the family. If an opium derivative is necessary, codein (½ to 1 grain) in combination with acetylsalicylic acid or phenacetin should be used.

Local measures are often helpful, and the extent to which they may be employed was demonstrated by the scars on the first patient you saw. Counterirritation should be applied over the course of the nerve and may be given in various ways. The Paquelin cautery takes first place, but does not need to be applied very vigorously. It is not necessary to do more than touch the skin superficially. The use of blisters and the application of mustard may give relief, but always keep in mind that these measures should be used in moderation, as the patient may have to lie in bed for some time.

Acupuncture has been employed and sometimes gives relief. Injections of sterile water or weak cocain solutions may give temporary relief, but there is danger of paralysis, which has resulted in some cases. The injection of solutions which may injure the nerve is not advisable. The operation of stretching the nerve has very properly gone out of use.

In chronic cases it is natural that a variety of treatments should be tried. Hydrotherapy is sometimes of value, but more often gives only temporary relief. Both it and massage are contraindicated when the condition is acute. Electricity sometimes gives temporary relief to the pain, but in general its use is disappointing.

General measures should be employed when indicated. Iron and arsenic are essential if anemia is present. A syphilitic sciatica requires the usual specific treatment. A special diet is only indicated in cases of sciatica due to gout or diabetes. The advice to cut out red meats from the diet does not seem to have any proper basis, unless for some other reason you wish to reduce the protein intake.

Essentially the treatment of sciatica should be based on the removal or correction of the cause. Till this can be accomplished we should endeavor to relieve the pain, but this is to be regarded as only palliative and not curative.

CLINIC OF DR. JAY FRANK SCHAMBERG AND DR. ALBERT STRICKLER

JEFFERSON MEDICAL COLLEGE

INTRASPINAL THERAPY IN SYPHILIS

THE medical profession is essentially conservative in placing the stamp of its approval upon new therapeutic procedures. No fault can be taken with this attitude, as medical history is replete with instances of new methods of treatment loudly heralded by their advocates and confirmed by others as important advances in the healing art, which were, after maturer trial, consigned to well-deserved oblivion. On the other hand, genuine and at times important contributions to our therapeutic knowledge are often viewed with obstinate incredulity for too long a period. One need only recall to mind the heated controversies of Harvey, Jenner, Pasteur, and Lister, and the difficulties they had to overcome to persuade a skeptical profession of the truth of their theses.

There are many physicians today who are still unconvinced of the value of intraspinal medication in syphilis of the nervous system. A sufficient experience has, however, accumulated to enable one to definitely state that this method of treatment must be regarded as a valuable, if not indispensable, addition to our therapeutic procedure.

We have been employing intraspinal treatment for several years. Our earlier results were not particularly encouraging, and we abandoned this treatment for some time, but results which were achieved from time to time have convinced us of the indispensability of this method of treatment in appropriate cases.

We present the history of a group of cases in which intraspinal treatment was employed. The facts speak for themselves.

CASE I.—J. C., twenty-nine years of age, was infected in 1908. He took mercurial pills steadily for three years under the

advice of his family physician. One year later his Wassermann was said to be negative. With the consent of his physician he married. He came under the care of one of the essayists in March, 1918. Patient is a vigorous specimen of manhood with well-developed musculature and weighing 180 pounds. He recently had a Wassermann test made both before and after a salvarsan injection, and the tests were reported as negative. He has two children, who are robust and healthy in appearance.

Examination revealed a sluggish reaction of the left pupil and impaired patellar reflexes, which later were entirely lost. No Romberg; gait normal. Patient complained of being "nervous." The blood Wassermann, on examination by Dr. John A. Kolmer, was $+^4$, with three different antigens. (It was reported negative by a technician in another city but a short time before.) The spinal fluid findings were as follows: cells 50: W. R., cholesterinized antigen $+^1$, alcoholic extract syphilitic liver $+^1$, acetone insoluble lipoids $+^4$. (A moderately positive Wassermann.) Protein showed a trace both by the Pandy and Noguchi tests. The colloidal gold test exhibited a suggestive luetic zone curve—0011110000.

The patient received on 4/17/18 0.6 gram arsphenamine intravenously, followed by the intraspinal injection of autoarsphenamized serum, to which $\frac{1}{4}$ milligram of arsphenamine was added. On 5/1/18 he was given 0.6 gram of arsphenamine, followed by spinal drainage. The spinal fluid at this time showed a marked improvement over the test made two weeks previously: spinal Wassermann $+^2$ — $+^1$ with 1 c.c. of fluid. The cells were reduced to 21. Protein, a trace. Gold test, 0011000000. 5/22/18 0.6 gram arsphenamine intravenously, followed by spinal drainage, 24 c.c. being withdrawn. On 5/24/18 the blood Wassermann was $+^3$ $+^1$ $+^2$ (a moderate positive). The patient reported again 6/18/18, at which time the pupils responded to light with greater alacrity. The right pupil was normal; the left a little less responsive; 6/18/18 spinal fluid W. R. negative; cells 9; gold test negative. The blood Wassermann was still moderately positive, $+^3$ $+^2$ $+^2$. The patient had lost his nervous feeling and declared himself to feel normal in every respect. In

this case the pathologic spinal findings were restored to normal within a short period of time, although the blood Wassermann was practically unchanged. To be sure, the spinal fluid must be further studied to make sure that the findings do not deteriorate. The patient is still under treatment.

CASE II.—C. S., age thirty. Infection took place two years ago. The patient was treated by intravenous injections of arsphenamine. He had two negative blood tests at intervals of two months, several months prior to the patient's visit to us. The spinal Wassermann was ++++, with all of the antigens employed. In March, 1918, he developed a diplopia. The eyes had never exhibited evidence of inflammatory trouble, but since the fall of 1916 his vision progressively failed. In May, 1917, Dr. T. B. Holloway examined his eyes and found "the vision in the right eye 6/60, with —1.00 = —.75 cyl. ax. 15, and the vision in the left eye 6/21, with —1.25 S. = —.50 cyl. ax. 90. The pupils measured 6 mm. and were slightly irregular in contour. They reacted slightly to accommodation and convergence, but not to light. There was a partial paralysis of the right sixth nerve, with practically complete paralysis of the left sixth, together with partial paralysis of the left third nerve. Each disk was markedly atrophic."

The patient was given twenty-four intravenous injections of arsphenamine with eighteen Swift-Ellis spinal injections, reinforced by the addition of ⅓ mg. of arsphenamine.

After this treatment the spinal Wassermann became negative. Dr. Holloway reports that "it is interesting to note that while the vision was progressively decreasing prior to the time the patient came under observation and treatment, that since the latter was instituted, the progress has apparently been checked. The optic atrophy has not shown any change, but a slight reaction to light has developed in the right eye during the course of treatment. There has been no decided improvement in the condition of the ocular muscles."

The interesting features of this case of *double optic atrophy* with *paresis of the ocular muscles* are the presence of a negative blood Wassermann, with a strongly positive spinal Wassermann,

and the apparent checking of the atrophy by intensive intravenous and intraspinal treatment. There can be little doubt that this patient's vision could have been saved if a diagnostic spinal puncture had been made earlier and appropriate treatment instituted.

CASE III.—S., age twenty-three. Patient developed a chancre in December, 1917, followed by a secondary eruption and mucous patches.

In March, 1918, the patient developed retinal hemorrhages. His nervous system, heart, and lungs were normal as far as any discoverable evidence could be elicited. The blood Wassermann was weakly positive. The spinal fluid findings were as follows: cells 10, Noguchi globulin test weakly positive; spinal Wassermann weakly positive. He received from us twelve intravenous injections of arsphenamine in 0.4 to 0.6 gram doses without any material improvement of the retinal hemorrhages. On 5/24/18 he received a Swift-Ellis spinal treatment, reinforced by $\frac{1}{4}$ mg. of arsphenamine. The blood Wassermann became negative; the spinal Wassermann was weakly positive. On 6/24/18 he again received an intraspinal treatment containing $\frac{1}{3}$ mg. arsphenamine. The spinal fluid then became Wassermann negative. Dr. Luther C. Peter, who examined the patient's eyes, reported that after the second intraspinal treatment the retinal hemorrhages exhibited a marked improvement.

Ordinarily retinal hemorrhage is favorably influenced by intravenous administration of arsphenamine, but in this patient much better results were obtained by the conjoined use of intraspinal treatments.

CASE IV.—B. K., age forty, came to see us complaining of pains in the back, legs, and loss of sensation in both feet. Duration two years. There was no history of a syphilitic infection; the wife and children were Wassermann negative. The patient's blood Wassermann was ++++. Examination revealed Argyll-Robertson pupils, marked Romberg, and absent knee-jerks. The patient received five intravenous injections of arsphenamin, with very little improvement. The spinal fluid was ++++, with three different antigens. The cells were not counted. The

Noguchi globulin test strongly positive. Diagnosis, tabes dorsalis. The patient received five intraspinal arsphenamine treatments (Swift-Ellis-Ogilvie technic) at intervals of two weeks. After this treatment the globulin test became negative, but the blood and spinal Wassermanns remained++++. The pains in the back and legs practically disappeared. His gait is improved as regards stability of footing and he no longer suffers formication in the feet.

CASE V.—M. B., age forty-three. Patient had initial lesion fifteen years ago, followed by secondaries. He was treated with mercury by mouth for one year. He complains of weakness in the legs and feet, shooting pains, and difficulty in walking. Duration two years.

The patient presents Argyll-Robertson pupils, marked Romberg, and absent knee-jerks. No changes in sensation. The peripheral vessels show marked arteriosclerosis. Diagnosis, tabes dorsalis. The blood Wassermann is ++++; the spinal Wassermann is ++++. Cells 30. Globulin positive. The patient received twelve intravenous injections of arsphenamine and ten intraspinal treatments. He was then allowed a rest of several months. On his return the blood Wassermann was $+^{1}$, with a cholesterinized antigen, and negative with extract syph. liver and acetone insoluble lipoids. The spinal Wassermann was $+^{4}$, with cholesterinized antigen, $+^{1}$ with alcoholic extract syphilitic liver, and $+^{3}$ with acetone insoluble lipoids. The globulin test (Pandy and Noguchi) was negative and the cells had been reduced to 3 per cubic centimeter. The patient's pains are decidedly less and his walking is distinctly improved. He later received three more intravenous and intraspinal treatments. The blood Wassermann became negative, but the spinal Wassermann relapsed to a ++++. The globulin was negative and the cells normal.

CASE VI.—O. C., age forty-three. No history of syphilitic infection. Patient complains of weakness in left arm and leg, and of double vision. Duration of symptoms one year. The pupils are small and irregular and react but slightly to light. The left knee-jerk is increased; the right is normal. Left ankle

clonus present; right side absent, no Babinski. No changes of sensation. The blood Wassermann is ++++; the spinal Wassermann is negative. Cells not counted. Globulin test positive. Diagnosis, syphilitic meningomyelitis (?). The patient received fourteen intravenous injections of arsphenamine. At the end of this course of treatment the blood Wassermann was still ++++. The patient was then given reinforced Swift-Ellis spinal treatments; after this treatment the spinal Wassermann changed from negative to ++++, apparently a provocative Wassermann. After the second intraspinal treatment the patient was so markedly improved that he resumed his work and wrote that he felt that he did not require further treatment.

CASE VII.—W. W. S., age forty-three. Infection in March, 1903. Had an initial lesion and a generalized eruption. Took mercury pills for a month or two. No further treatment until 1918. Sought medical advice in 1918 because of diplopia. The pupils are irregular and small. Right pupil does not react to light; the left sluggishly. There is a ptosis of the right upper eyelid. The patellar reflexes are greatly exaggerated. In the right leg the Babinski is plus; in the left leg, normal. The Romberg is pronounced; approximation of fingers with the eyes closed is poor. Gait is fairly good. Some vesical dribbling. The blood Wassermann is $+^4$, the spinal Wassermann is likewise $+^4$. There were but three cells to the cubic centimeter. There was an increased amount of globulin, and the Lange gold test showed a tabetic curve.

The patient has received seven intraspinal injections of arsphenaminized serum following intravenous injections upon the same or on the previous day. The patient is much stronger, he is steadier on his feet, and the co-ordination of his hands has improved. The diplopia and the ptosis have likewise improved greatly, although a trace of each remains. The blood and the spinal Wassermann both remain strongly positive.

CASE VIII.—J. L., age fifty-two. Infection dates back nineteen years. Local treatment applied to initial lesion. No internal treatment.

Present complaint is weakness in the legs and burning sensation in the feet. The patient likewise complains of pains in the stomach. Duration of these symptoms ten years.

Physical examination reveals an Argyll-Robertson pupil, absent knee-jerks, and extremely poor station. The blood Wassermann is $+^4$; the spinal Wassermann is $+^4$. The Pandy and Noguchi globulin tests are positive. The colloidal gold test is suggestive of the paretic curve. Cells not counted.

Patient received Swift-Ellis intraspinal treatments reinforced with $\frac{1}{4}$ to $\frac{1}{3}$ mg. of arsphenamine, at intervals of two to three weeks. The blood Wassermann and the spinal Wassermann are still strongly positive, but there is pronounced clinical improvement. The patient is stronger, steadier upon his feet, and walks almost normally.

Case IX.—Age fifty-three. Initial lesion nine years ago. A secondary eruption was not observed. The patient received no internal treatment. The patient seeks medical advice because of vertigo and pains in the legs of three months' duration.

Physical Examination.—The patient has a leukoplakia of five years' duration. The eyes react to light and distance. An arcus senilis is present. The knee-jerks are exaggerated. The Babinski test and ankle-clonus are normal. No disturbance of sensation. Moderate degree of arteriosclerosis is present. The blood Wassermann is $+^4$, as is likewise the spinal Wassermann. The Noguchi globulin test is positive. There are 20 cells to the cubic centimeter. The colloidal gold test is negative. The patient received twenty intravenous injections of arsphenamine. The Wassermann reaction after this treatment remained unchanged. The patient then received three modified Swift-Ellis intraspinal treatments, after which the blood Wassermann became reduced to a moderate positive. There was distinct improvement in the vertigo and pains in the legs. After three more intraspinal treatments the pains and vertigo disappeared. The blood Wassermann was moderately positive, the spinal Wassermann $+^4$. He has now been without treatment for four months and still maintains his clinical improvement.

Case X.—R. C. S., age thirty-six. Initial lesion fifteen years

ago. No internal treatment. Patient complains of staggering and shooting pains and loss of power in legs; great difficulty in walking. Duration of these symptoms three years.

Physical examination reveals absent knee-jerks and marked Romberg symptom. The blood Wassermann is $+^4$, as is also the spinal Wassermann. Cell count is normal. Noguchi globulin test negative. Collodial gold test normal.

The patient received twelve intravenous injections, with some improvement in his gait. The blood Wassermann remained $+^4$. The patient then received ten reinforced Swift-Ellis intraspinal treatments at intervals of two to three weeks. The blood and spinal Wassermanns still remained $+^4$.

The clinical improvement was, however, marked. The Argyll-Robertson pupil disappeared, the pupils reacting to light. (This is the only case in which we have observed the restoration of the pupillary reaction.) The pains in the legs disappeared and the gait became markedly improved. The extent of the improvement in walking may be appreciated when it is stated that whereas the patient leaned heavily on a cane when he first came under treatment, he later was able to completely dispense with it. The patient's station is improved, but the knee-jerks are still absent.

Case XI.—J. T., age thirty-three. No history of infection. The patient complains of staggering and loss of power in the left arms. Duration of symptoms two years.

Examination disclosed absence of the knee-jerks and tendo achillis reaction. Argyll-Robertson pupil and Romberg symptoms present. There is distinct impairment of motor power in the left arm to such an extent that the patient cannot continue his work as a railway conductor. No loss of sensation. Moderate degree of arteriosclerosis. The blood Wassermann and the spinal Wassermann are $+^4$. The Noguchi globulin test is positive; the collodial gold test is negative; the cells were not counted.

The patient received eleven intravenous injections of arsphenamine, with but slight change in his physical condition. The blood Wassermann remained $+^4$. After the first modified Swift-Ellis spinal treatment the blood Wassermann was reduced

to a weak positive. The patient then received eight more intraspinal treatments at intervals of two to three weeks. After this treatment the blood Wassermann became negative, although the spinal Wassermann remained $+^4$. There has been pronounced clinical improvement. The staggering is considerably improved and there has been recovery of the power in the arm to such an extent as to permit the patient to return to his former occupation. At the end of four months, without treatment, the improvement was maintained.

CASE XII.—D. D. G., age forty-seven. Initial lesion eighteen years ago. No secondaries observed. The patient took mercury by mouth for one year. During the past year the patient has had two intravenous injections of arsphenamine and a course of mercurial rubbings. The patient was brought to the hospital with paralysis of the lower extremities; complete inability to use the legs. The loss of power in the legs began a year ago, but has progressed rapidly during the past three months. The pupils are unequal, but react to light. The knee-jerks and Babinski are present. No loss of sensation. Diagnosis, myelitis syphilitica. The blood Wassermann is $+^4$; the spinal Wassermann negative. The Noguchi globulin test and the collodial gold test are likewise negative. Cells, 11 to the cubic centimeter.

The patient was given four modified Swift-Ellis treatments, after which the spinal Wassermann became a weak positive.

The clinical improvement has been remarkable, the patient is now able to walk without any support. The patient was given four more intraspinal and intravenous treatments, and left the hospital *with complete* restoration of power in the legs and able to walk perfectly.

The blood Wassermann was still + and the spinal Wassermann negative.

CASE XIII.—H. L., age thirty-one. Patient contracted syphilis in 1907; initial lesion and secondaries. Mercury was given by the mouth for one year. In 1913 the vision became blurred; later it improved without treatment, but subsequently he grew progressively worse and became totally blind in 1917.

Diagnosis: Double optic atrophy. Between March, 1916, and March, 1918, the patient received fourteen intravenous treatments of arsphenamine and four intraspinal treatments. The knee-jerks are absent. The blood and spinal Wassermann are both $+^4$. The colloidal gold test and the Noguchi and Pandy globulin tests are negative. The cell count is 4 to the cubic centimeter. The patient received six further modified Swift-Ellis intraspinal treatments. Treatment was without avail and the patient is today totally blind.

CASE XIV.—I. B., age fifty-five. Patient complains of pains in both legs, as well as vertigo and difficulty in walking. There is also considerable vesical weakness. Duration of symptoms about thirty years (?).

Examination discloses Argyll-Robertson pupils and a positive Romberg. The knee-jerks are absent; no loss of sensation.

Diagnosis: Tabes dorsalis. The blood Wassermann is $+^3$ and the spinal Wassermann is $+^4$. The Noguchi globulin test is negative; 8 cells to the cubic centimeter. The colloidal gold test is suggestive of a paretic curve. The patient received three intravenous injections of arsphenamine at weekly intervals, with but slight improvement. He then was given three modified Swift-Ellis treatments at intervals of two weeks. After this treatment the vertigo disappeared, the gait was markedly improved, and the patient increased greatly in strength. The blood and spinal Wassermanns remained unaltered.

CASE XV.—B. H. W., age fifty-eight. Lues contracted about twenty-eight years ago. Treatment by mouth for a couple of years.

The patient came under the care of one of the writers eight years ago. At that time he had a severe osteoperiostitis of the left leg. He complained of general rheumatoid pains. He exhibited Argyll-Robertson pupils. Knee-jerks slightly exaggerated; station good. No bladder symptoms. Under intravenous injections of arsphenamine the osteoperiostitis and pains completely disappeared. The blood Wassermann was $+^4$, and, despite over forty intravenous injections of arsphenamine and neo-arsphenamine, insoluble mercurial injections, and adminis-

tration of the iodids, the Wassermann has remained practically unchanged. In May, 1918, a spinal puncture was performed. The spinal Wassermann was negative; the Pandy and Noguchi tests positive. There were 3 cells to the cubic centimeter. The colloidal gold test exhibited a distinct luetic zone curve—0012221000. The patient was averse to receiving intraspinal injections, and, owing to his age, the matter was not pressed. His intellection is normal, his memory good, and there are no physical stigmata except the Argyll-Robertson pupil and a pronounced leukokeratosis of the tongue. The patient has a mild grade of myocarditis and has lost strength and weight during the past year, during which time he has had less treatment than in any period during the past eight years.

Persistent intravenous treatment combined with the use of mercurials appears to have prevented any marked advance in the nerve lesion during the past eight years. The blood Wassermann remains unchanged.

Case XVI.—Dr. X, age fifty-six, presented himself two years ago complaining of tinnitus aurium and attacks simulating "petit mal," during which he would fall to the ground. On account of pronounced flushings of the face, several physicians had diagnosed vasomotor ataxia. The patient had no knowledge whatsoever of a luetic infection. His blood Wassermann was strongly positive. The patient was markedly neurasthenic and apprehensive. His pupils reacted well to light and the patellar reflexes were distinctly exaggerated.

The patient was given, during the course of a year and a half, over twenty intravenous injections of arsphenamine, mercury injections, and the iodids. Despite these treatments the patient's condition became worse. He developed paraphasia, employing inappropriate words in speaking. His speech became hesitating and incoherent, and his memory and his mind deteriorated to such an extent that it became necessary to remove him to a hospital. Here he was so irrational that he dipped his toothbrush into the urinal.

The spinal fluid was Wassermann negative; cells 8; negative globulin test; the colloidal gold test showed a distinct luetic zone

curve. Thirty-six hours after receiving a modified Swift-Ellis treatment his mind suddenly cleared up and his speech became normal. After two more intraspinal treatments he was dismissed from the hospital. Six months later, although still apprehensive and neurasthenic, his mind and speech were normal. The so-called "petit mal" attacks had ceased completely and the tinnitus aurium was distinctly improved. The blood Wassermann became negative.

RATIONALE OF THE TREATMENT

No conclusive deduction can be drawn as to the reason why the combined intravenous and intraspinal injections effect better results than the intravenous alone. The amount of arsphenamine in 15 c.c. of the patient's blood-serum is extremely minute. Even if $\frac{1}{4}$ to $\frac{1}{2}$ mg. is added *in vitro*, after the method of Ogilvie, the amount of the drug that would be thrown into the spinal canal would seem to be too small to accomplish the results achieved.

The explanation of the beneficial results may be that the blood-serum sets up a mild aseptic meningitis, and this process increases the permeability of the choroid plexus to the passage into the spinal fluid of the arsphenamine-charged blood plasma. Other physical conditions induced by the injection of blood-serum into the subdural space may likewise be operative. Dr. Francis X. Dercum, of this city, states that he has seen on many occasions improvement in the symptoms of nerve syphilis brought about by the injection into the spinal canal of plain blood-serum.

The histories above presented offer considerable material for commentary.

One of the most important questions in the controversy which has arisen as to the value of intraspinal medication in syphilis of the nervous system is, Will intraspinal treatment achieve that which cannot be accomplished by other means? For our own part, that query is answered by the results obtained in patients in whom intravenous medication was first tried with negative or mediocre results, and in whom combined intravenous and intraspinal treatment afterward brought about brilliant results.

Case XVI is a striking example of this. This patient had numerous intravenous injections of arsphenamine associated with the use of mercury and iodids administered in approved form. Not only was there no improvement, but the patient grew progressively worse and became incoherent and irrational. Thirty-six hours after the first combined intravenous and intraspinal treatment the patient's mind and speech suddenly cleared up, and have remained normal up to the present time—a period of seven months.

Case X, a case of tabes dorsalis, received twelve intravenous administrations of arsphenamine, with but slight improvement in his symptoms. Ten combined intravenous and intraspinal treatments effected an astounding change in the patient's ability to walk. After this the patient discarded the cane upon which he had relied for a long period.

Case XI exhibited but slight improvement in the muscular power of his arm after eleven intravenous treatments, whereas after nine combined intravenous and intraspinal injections he was restored to such efficiency as to enable him to resume his usual occupation.

INADEQUACY OF TREATMENT AND NERVE SYPHILIS

A striking feature of the above detailed histories is that practically all of the patients had totally inadequate treatment. In 25 per cent. of the patients the disease was unsuspected until nerve symptoms set in some years later. It is now realized that syphilis may occur without any local lesion recognizable clinically as a chancre. If it is ultimately proved that there is a special strain of spirochetes which have an affinity for nerve structure it may possibly be demonstrated that infection with such strains induces relatively little reaction in cutaneous and mucous tissues.

Another plausible explanation of unsuspected syphilis is that there may be a synchronous infection of gonorrhea and syphilis, the chancre being located in the urethra. Whatever the true explanation may be, the fact remains that we encounter many cases of late syphilis in patients in good social standing

who have no knowledge of a chancre or of any other antecedent manifestations.

During the secondary stage or period of vascular diffusion of the spirochetes these parasites are carried to the central nervous system, and either bring about inflammatory changes in a few months or years, resulting in the exudative forms of nerve syphilis, or in the course of years insidiously lead to inflammatory and degenerative types, such as tabes dorsalis and paresis.

THE BLOOD WASSERMANN AND THE SPINAL FLUID WASSERMANN

In this series of 16 cases of nerve syphilis the blood and the spinal Wassermann were studied in each case. The blood Wassermann was strongly positive in 15 cases. In one case of optic atrophy it was negative. The spinal fluid Wassermann was strongly positive in 11 cases; in one case of very early tabes with no symptoms save absent knee-jerks and inequality of the pupils, it was a weak to a moderate positive. In one case of meningomyelitis and one of transverse myelitis the spinal Wassermann was negative. It was likewise negative in a patient with long-standing syphilis exhibiting an Argyll-Robertson pupil and a resistant and strongly positive blood Wassermann. The spinal fluid showed increased protein and a distinct luetic zone curve with the colloidal gold test. In another case of pseudoparesis (probably a cerebral arteritis) the spinal Wassermann was negative.

In 6 cases of tabes dorsalis both the blood and spinal Wassermanns were strongly positive. Cases in which nerve syphilis exists with a negative blood Wassermann are not, however, rare. In a patient under our care at the present time, who exhibited evidences of a profound neurasthenia, there was no history of a syphilitic infection and the blood was Wassermann negative. The spinal fluid, however, was strongly positive. A prominent neurologist who examined this patient believes him to be suffering from incipient paresis.

Another patient, thirty-five years of age, with treated syphilis of two years' standing, presented himself with neurasthenic

symptoms and a negative blood Wassermann. A spinal puncture revealed a strongly positive Wassermann. The patient delayed treatment and a few weeks later developed a hemiplegia.

Cases such as this indicate the imperative necessity of diagnostic spinal puncture in all cases of syphilis. Surely no case of syphilis should be released from observation without an examination of the spinal fluid.

SIGNIFICANCE OF LABORATORY FINDINGS

The existence of a strongly positive blood Wassermann indicates the presence of living spirochetes in the body. A strongly positive spinal Wassermann is evidence of the involvement of the central nervous system.

The evidential value of a negative blood Wassermann or a negative spinal Wassermann is much less conclusive than that of a positive reaction. We know definitely that the blood may be negative in the presence of indubitable syphilitic lesions; the same statement may be made with reference to the spinal Wassermann test.

A marked increase of the cells in the spinal fluid indicates exudative or inflammatory changes usually involving the meninges; the greater the number of cells, the more pronounced the inflammatory activity.

Lange's colloidal gold test is a valuable addition to our laboratory technic. It is of value in indicating a pathologic state of the spinal fluid, even when the cells, protein and Wassermann, are negative. It is also of differential diagnostic and prognostic value. It is of special usefulness in differentiating tabes and cerebrospinal syphilis from paresis. Its findings are not absolute, however, as a characteristic paretic curve may occasionally occur in cases of cerebrospinal syphilis. Wisdom and experience both indicate that clinical and laboratory findings should be weighed side by side and deductions drawn from a careful study of all of the available evidence. Such a course will lesson errors of diagnosis, prognosis, and treatment.

THE EFFECT OF TREATMENT UPON THE CLINICAL AND LABORATORY FINDINGS

While it is true that a certain relationship exists between the extent of the clinical manifestations and the intensity of the pathologic findings in the spinal fluid, yet there are many exceptions to this generalization. Both the clinical and the laboratory findings may be favorably influenced by treatment, but there is often an absence of parallelism in the improvement. The clinical symptoms are usually influenced to a greater extent than the pathologic findings.

Sensory and motor disturbances are apt to yield first to treatment. Sexual power, when impaired, is commonly strengthened; the gait is often astonishingly improved. The mobility of the pupil may be bettered, and in rare cases an Argyll-Robertson pupil may be made to disappear. It is extremely difficult to influence a lost patellar reflex. These improvements may take place while no change occurs in the laboratory findings of the spinal fluid. In other cases a pronounced and progressive improvement in the spinal findings may take place under systematic treatment. The cellular count is commonly reduced after a few treatments. Influence upon the Wassermann and gold test is more slowly effected.

We have had several cases in which intraspinal treatment produced a negative blood test after intravenous treatments alone had failed to achieve this result.

We have also observed in several instances what appeared to be a provocative spinal Wassermann, the reaction being negative before treatment and positive afterward. The goal to be aimed at should be the disappearance of clinical symptoms, and the extinction of the pathologic findings in the blood and spinal fluid. In some cases this consummation, devoutly to be wished, cannot be achieved. Patients are often grievously disappointed because the blood or the spinal Wassermann remains positive despite repeated courses of treatment. Under such circumstances they should be informed that each added course of treatment increases the insurance against future disability.

In conclusion, a word must be said about the limitations of

intraspinal therapy. One can never hope to restore degenerated nerve tissue. In advanced cases of paresis or tabes intraspinal treatment may, in some instances, aggravate, rather than improve, the condition of the patient. Paresis cannot be cured unless treatment is begun at an extremely early stage. The most favorable time for treatment is before clinical evidence of paresis develops. A routine examination of the spinal fluid in all cases of syphilis would enable physicians to detect the pre-paretic stage by the spinal fluid findings. Systematic treatment at this time would doubtless prevent this unfortunate eventuality. The same statement is to a greater extent true of other forms of nerve syphilis which are more amenable to treatment. We must have numerous well-equipped institutions and well-trained men to carry out the arduous work which such systematic examinations and treatments would entail.

CLINIC OF DR. ELMER H. FUNK

JEFFERSON HOSPITAL

CHYLOTHORAX

Patient No. 1.—Chylothorax. Introduction. True and Spurious Forms. Frequency. History and Clinical Notes of Patient. Discussion. Anatomy of Thoracic Duct. Etiology of Chylothorax. Clinical Manifestations and Diagnosis. Prognosis and Treatment.

INSTANCES of effusion in the serous cavities having a milky appearance are decidedly uncommon. Such collections are met with most often in the peritoneum, less frequently in the pleura, and only very rarely in the pericardium. Milky effusions in the pleural cavity are so rare that many clinicians of experience have never seen a case. Bartolet in 1633 was the first to describe an effuson of this type. In discussing miky pleural effusions it is well to keep in mind that they are of two principal varieties: (1) the true chylous, in which, as a result of a lesion of the thoracic duct, chyle finds its way into the pleural cavity, and fat is present in the fluid, and (2) the pseudochylous, in which the milky appearance is not due to fat, but to a lecithin globulin complex held in suspension by the inorganic salts present (Wallis and Schölberg). Some writers have added a third variety—the chyliform—in which the milky appearance of the effusion is due to the fat present, resulting from fatty degeneration of cellular elements. Henry states that it is questionable whether the milky appearance can be entirely due to this cause. Only the first variety represents true chylothorax and is the form we are discussing today in the presentation of our patient.

Lewin in 1916 was able to find only 51 cases of chylothorax in the literature since Bartolet's time. F. T. Lord is of the opinion that they are probably more common than the number of

reported cases would indicate, since chylous may be readily confused with purulent fluid unless carefully examined. Since 1916 I have been able to find two reports in the literature (Pisek, 1917; Brekke, 1917), making 54 cases to the present time. The following is the history and clinical notes of this patient:

T. S. B., male; colored; aged forty-two years; physician; admitted to the Jefferson Hospital August 28, 1918.

Chief Complaint.—Shortness of breath upon slight exertion.

Family History.—Father died at eighty-four years of apoplexy. Mother, six brothers, and two sisters are living and well. One brother died at twenty-four years of typhoid fever.

Personal History.—Measles, mumps, chicken-pox, and whooping-cough in childhood; typhoid fever complicated by phlebitis of left leg at twenty-two years; rheumatic fever with prompt convalescence at twenty-six years; diphtheria at thirty-five years.

Present Illness.—One month prior to admission he noticed an increasing shortness of breath upon exertion, associated at times with slight vertigo. He was also distressed with palpitation upon exertion; otherwise he had no complaint—no pain, cough, night-sweats, or fever were evident. About ten days after the onset he took to his bed because of weakness and dyspnea, and was examined by a fellow practitioner, who diagnosed the presence of fluid in the left chest. He was aspirated and about 4 quarts (!) of milky fluid withdrawn. The aspiration was followed by a prompt relief from symptoms, which lasted for three or four days, and then returned as the fluid reaccumulated. One week later he was aspirated again and 3 quarts (!) of milky fluid removed. This aspiration, like the first, was followed by relief from the shortness of breath and palpitation for a few days, but they returned again shortly before admission to the hospital.

Physical Examination.—Patient is a well-developed, well-nourished adult male. The eyes, ears, nose, mouth, and throat are negative. Examination of the neck reveals no glandular enlargement. The chest is well developed and shows some bulging on the left side below. The expansion on this side is restricted, especially in the lower portion; over the entire left base are flatness, diminished vocal fremitus and resonance, and dis-

tant breath sounds. No râles are audible anywhere in the chest. The heart is moderately displaced toward the right. The heart sounds are fairly good; no murmurs are audible. The abdominal examination is negative. The extremities are negative. The urine is negative. The sputum shows no tubercle bacilli.

Progress.—Five days after admission the patient was quite dyspneic, and it was thought advisable to aspirate—3000 c.c. of milky fluid were removed from the left chest. Following the aspiration the patient was considerably relieved. The aspirated fluid was examined, with the following result: Specific gravity 1023, total nitrogen 0.70 per cent., protein 4.38 per cent., fat 1.8 per cent., sugar 0.11 per cent. There was considerable fibrin present. This was removed before the determination for nitrogen and protein was made.

Discussion.—Before discussing those conditions which may produce chylothorax, it may be well to refresh our memory briefly with regard to the anatomy of the lymphatic vessels as they pass through the thorax. The lymph coming from all parts of the body is collected into two tubes—the right lymphatic duct and the thoracic duct. The *right lymphatic duct* is smaller and collects the lymph from the right side of the head and neck, right arm, right side of chest, and the upper convex surface of the liver. The various lymphatics unite to form a duct 1 or 2 cm. long which empties into the venous system at the junction of the right internal jugular and subclavian veins. Of greater importance, because it conveys chyle in addition to a great mass of lymph into the blood, is the left lymphatic duct, or *thoracic duct.* It originates in the abdomen at the receptaculum chyli at the level of the second lumbar vertebra; enters the thorax through the aortic opening of the diaphragm to the right of the aorta, and traverses the posterior mediastinum between the aorta and vena azygos major. As it ascends it lies on the bodies of the seven lower thoracic vertebræ with the pericardium, esophagus, and the arch of the aorta in front. At the level of the fifth thoracic vertebra it inclines toward the left side, ascends behind the arch of the aorta on the left of the esophagus, and behind the first portion of the subclavian artery. At the level of the

seventh cervical vertebra it turns outward and then downward over the left pleura, subclavian artery, and scalenus anticus, and empties into the venous system at the junction of the left internal jugular and subclavian veins. At its commencement there is a dilatation called the receptaculum chyli, and in its course it is flexuous and constricted at intervals, giving to it a varicose appearance. Not infrequently it divides in the middle of its course into branches which reunite, forming a plexiform interlacement. It has valves throughout its course which are more numerous and more competent in the upper portions, and a very efficient pair is present at its termination to prevent the passage of venous blood into the duct. In some instances there are several terminations of the duct, and Wendel believes that it may anastomose with the right lymphatic duct and azygos veins, explaining thereby the lack of ill effects when it is ligated following injury in operations in the neck.

The *causes* of chylothorax are either (1) rupture of the thoracic duct or its radicles or (2) increased pressure within the duct leading to a backward flow of lymph along the pulmonary and pleural lymphatics. West states that in the majority of cases rupture is due to injury, but in a few to disease, and it is probable that the duct may be ruptured without much external sign of serious damage. West further calls attention to the fact that the thoracic duct may not be at fault, the lesion occurring in one of the larger lymphatics elsewhere in the thorax. Among the 47 cases collected by Baldwin in 1908 the causes were as follows:

	Cases.
Chest injury	16
Pressure upon duct by new growths or tuberculous glands	9
Secondary growths in duct	9
Thrombosis of left subclavian vein	4
Proliferating lymphangitis	2
Aneurysmal dilatation of duct	2
Thrombosis of duct	1
During operation for removal of carcinomatous glands of neck	1
Obstruction of duct from inflammatory thickenings in the mesentery	1
Mitral disease	1
Filaria	1
Total	47

The *clinical manifestations* of chylothorax are those of simple serous effusion, and the diagnosis is made by the exploring needle. Its nature is rarely suspected until the milky fluid is obtained, and then it may be mistaken for a purulent collection. A careful microscopic and chemical examination of the fluid will decide. There are seldom any subjective symptoms in the non-traumatic cases other than gradually increasing dyspnea and weakness. In our patient these were the only symptoms. Fever is usually absent, as in our case. The majority of the patients are adult males, although the condition may occur in infancy. Jennings reported before the American Pediatric Society in 1907 the case of a child of nine months in whom the aspirated fluid from the chest contained 3 to 4 per cent. of fat. The majority of cases of chylothorax occur on the right side (Edwards 60 per cent.), and in approximately one-third of the cases there is an accompanying chylous ascites. In our patient the accumulation was left sided and there was no demonstrable ascites. In the patient recorded by Rokitansky the chylothorax was bilateral and associated with chylous ascites. In de Mussy's patient the condition existed on the left side for fifteen years and was followed by recovery after three tappings. In Erb's patient 30 liters of chylous fluid were removed in eight tappings. Massing's patient presented bilateral chylothorax, chyloperitoneum, and chylopericardium.

The differentiation of true chylothorax from pseudochylous hydrothorax may at times present difficulties. The fluids may have a similar milky appearance. A milky fluid is more likely to be a true chylous rather than a pseudochylous fluid.

A true chylous fluid tends to accumulate rapidly, contains microscopically fine fat globules which stain readily with osmic acid and Sudan III; there are very few cellular elements. The specific gravity generally exceeds 1012, and although the total solids show considerable variations, a value below 4 per cent. is rarely found. The fat content is generally high, varying from $\frac{1}{2}$ to 4 per cent. The percentage of fat present in this case was $1\frac{8}{10}$ per cent. Lecithin occurs only in traces.

In pseudochylous effusions the fluid tends to accumulate less

rapidly, contains microscopically numerous fine highly refractile granules which do not give the reactions for fat. The cellular elements may be numerous and often contain fat. The specific gravity is usually less than 1012, and the total solids rarely exceed 2 per cent. The fat content is low and in many instances only a trace can be found. Lecithin is present in combination with globulin. This lecithin-globulin complex is the cause of the milky appearance of the fluid. Pseudochylous fluids resist putrefaction. This characteristic has been attributed to the lecithin. To those of you who wish to look into the matter of the differentiation of chylous and pseudochylous fluids, in more detail than I have given, I would recommend the very excellent articles by Wallis and Schölberg which appeared in the Quarterly Journal of Medicine for 1910 and 1911.

Prognosis and Treatment.—The perforation of the duct following injury or disease may close spontaneously if the opening is small. Radical treatment by operation upon the duct is not feasible at the present time in intrathoracic cases; in those instances in which the injury results from operation in the neck the duct may be ligated. Accidental injury of the duct in this way has occurred in the experience of many surgeons, and practically always without unfavorable results when ligated or packed. The inference has been that there are several terminations of the duct, or, as Wendel has pointed out, it anastomoses with the right lymphatic duct or with the azygos veins. The accumulation of chylous fluid in the thorax requires tapping if pressure symptoms are present, or if after a moderate wait the effusion shows no evidence of being absorbed. The fluid should not be entirely removed at one time or the tapping performed too frequently, as a certain amount of pressure may be necessary to prevent the escape of more fluid from the duct and to favor repair. Many of the reported tappings show large removals, frequently resorted to, and with an unfavorable termination. In fact, at the present time the treatment of chylothorax is most unsatisfactory. Treatment of the underlying condition is indicated, and if this is tuberculosis, the usual rest in bed with an abundance of fresh air and good nourishing food is essential.

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[1] Articles by Lewin and Wallis and Schölberg contain excellent bibliographies, by consulting which the literature is rendered readily available.

AORTIC ANEURYSM WITH ESOPHAGEAL RUPTURE

Patient No. 2.—Aortic Aneurysm. History and Clinical Notes of Patient. Death by Rupture into the Esophagus. Autopsy. Discussion of Esophageal Symptoms of Aneurysm and the Relative Frequency of Esophageal Rupture. Early Diagnosis of Aneurysm.

CLINICAL history and notes of H. C., male, white, aged fifty-two years; admitted to the Jefferson Hospital August 26, 1915:

Chief Complaint.—Cough of one year's duration and pain in the back between shoulders.

Family History.—Negative.

Personal History.—Chicken-pox at eleven years. Gonorrhea seven times, first when fifteen years old. He had a chancre in 1900, that is, fifteen years ago, followed by a rash over his entire body. A diagnosis of syphilis was made, but he received no systematic treatment. He states that he has always been in good health until the present trouble.

Present Illness.—One year ago he caught cold while working in the early morning on a farm, and the resulting cough has persisted until the present time. The cough is paroxysmal in character and is worse on some days and better on others. It is associated with a slight expectoration of a yellowish, mucoid material. The pain in the back is high up between the shoulders and is quite severe at times. It has been more or less constantly present. About six months prior to admission he was given a three weeks' course of potassium iodid, following which he felt considerably better.

Physical Examination.—Patient is a well-nourished, well-developed adult male. No cyanosis. No dyspnea. The pupils are equal and react to light and accommodation. The ears and nose are negative. The tongue is coated with a whitish fur. The teeth are in bad condition. In the neck a distinct tracheal tug can be obtained. The chest is well developed, although ex-

pansion is limited on both sides. The percussion note over the lungs is normal, the breath sounds quiet, and scattered piping râles are audible over the entire pulmonary area. The heart examination reveals the apex normally placed, no shock or thrill, no expansile pulsation with one hand on the front of the chest and the other hand on the back. The heart sounds are clear and distinct and without murmurs. The liver and spleen are not enlarged. There is a right incomplete inguinal hernia. The patella reflexes are absent.

Laboratory Tests.—The urine is of low specific gravity, contains a faint trace of albumin and a few granular casts. The blood shows Hb. 72 per cent., R. B. C. 5,230,000, W. B. C. 9200; differential count—large mononuclears 3 per cent., small mononuclears 36 per cent., polynuclears 60 per cent., eosinophils 1 per cent. The sputum shows no tubercle bacilli. The Wassermann test is positive, 4+. The *x*-ray examination shows a small aneurysm involving principally the first portion of the descending arch of the aorta.

Progress.—While in the hospital he remained for the greater part of the time in bed or in his chair. He complained a great deal of the pain in his back and of the distressing cough, which since admission had become quite productive of a yellowish, mucoid sputum. Three days before death he spat blood which seemed to come from the respiratory passages, because it occurred during the act of coughing. He had never vomited. On the morning of his death he seemed in his usual condition, although he stated he felt disinclined to eat. He was sitting on the edge of his bed when he called for the nurse, stating that he felt faint. He was urged to lie down, and in about fifteen minutes became quite pale. By the time the resident physician reached his bedside, in about ten or fifteen minutes more, he was dead, presumably with an internal hemorrhage. Some little blood exuded from his mouth while he was dying. There were no respiratory symptoms and we were led to a provisional diagnosis of rupture into the esophagus.

Autopsy.—The body was turned over to the State Anatomical Board because of lack of claim, and the Board sent it to our

Anatomical Institute, where cross-sections of the cadaver were made. These sections revealed the aneurysm with its esophageal relationship and the rupture into this structure. The esophagus, stomach, and intestines were filled with blood. The accompanying illustrations will show better than words the autopsy findings.

Discussion.—Symptoms referable to the esophagus are not of frequent occurrence in patients with thoracic aneurysm. In a few instances the early extension of the sac backward may give rise to dysphagia before other signs of the aneurysm are demonstrable. Cases are on record in which esophageal instruments have been passed for diagnosis, or for treatment, and the thin wall between the esophagus and aneurysm penetrated, resulting in immediate death from hemorrhage. Fortunately, such occurrences nowadays are rare, the fluroscope and the *x*-ray plate rendering the early diagnosis of aneurysm a relatively easy matter. A dysphagia present early in the development of an aneurysm may not be due to pressure, but to spasm due to pressure on the recurrent laryngeal nerve. A rather large-sized aneurysm may not give rise to any interference with the passage of food, or, just the opposite, may cause the greatest difficulty and, if ulceration is present, agonizing pain. In other patients the proximity to and involvement of the esophagus may not be suspected until a hemorrhage occurs. The perforation may not be fatal. If the opening is small and a clot forms, the perforation may close. If the opening is large, fatal bleeding may occur into the esophagus and externally, or the blood may pass into the stomach without appearing externally. Such a condition may be discovered only at autopsy.

In our patient aortic aneurysm was suspected because of the persisting pain, the harsh metallic cough existing for a year without demonstrable lung lesion in a man of fifty-two years with a history of syphilis, and in whom a definite tracheal tug was obtainable. This diagnosis was made in spite of the fact that no paramanubrial dulness or other local sign of aneurysm could be found on physical examination. The *x*-ray verified the diagnosis. The autopsy revealed its anatomic relation and showed

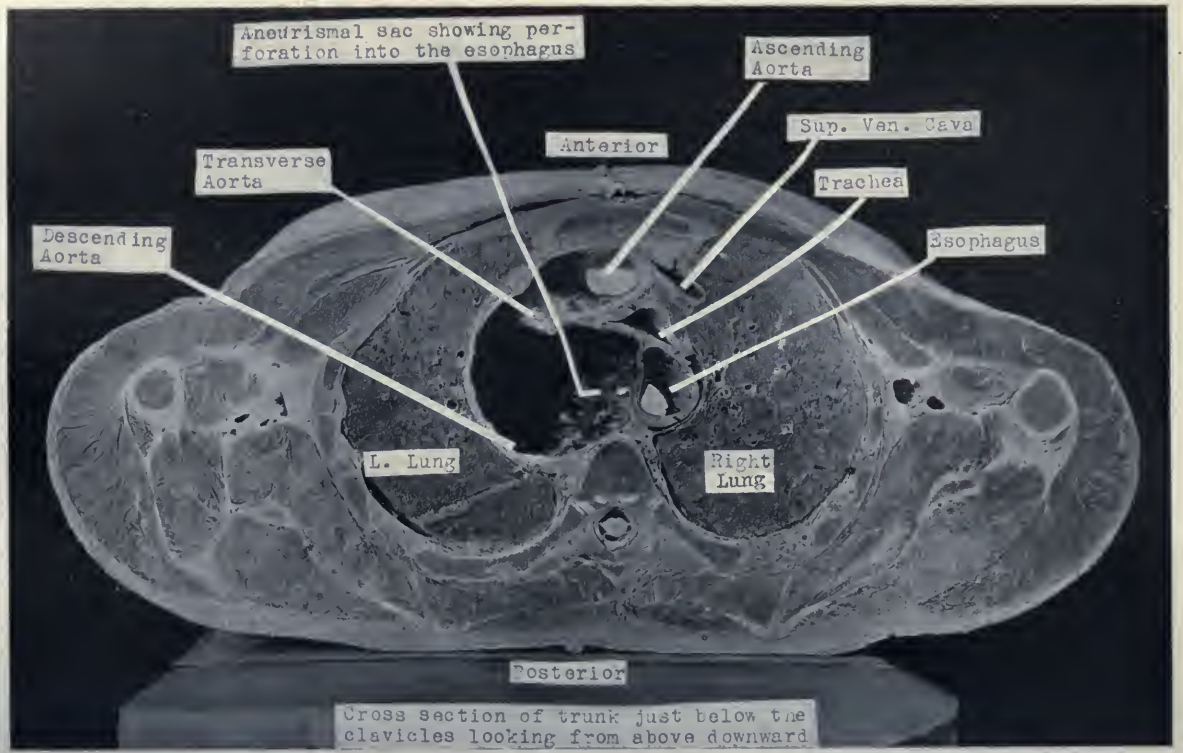
Aneurismal sac showing perforation into the esophagus
Ascending Aorta
Sup. Van. Cava
Anterior
Transverse Aorta
Trachea
Descending Aorta
Esophagus
L. Lung
Right Lung
Posterior
Cross section of trunk just below the clavicles looking from above downward

Fig. 142.

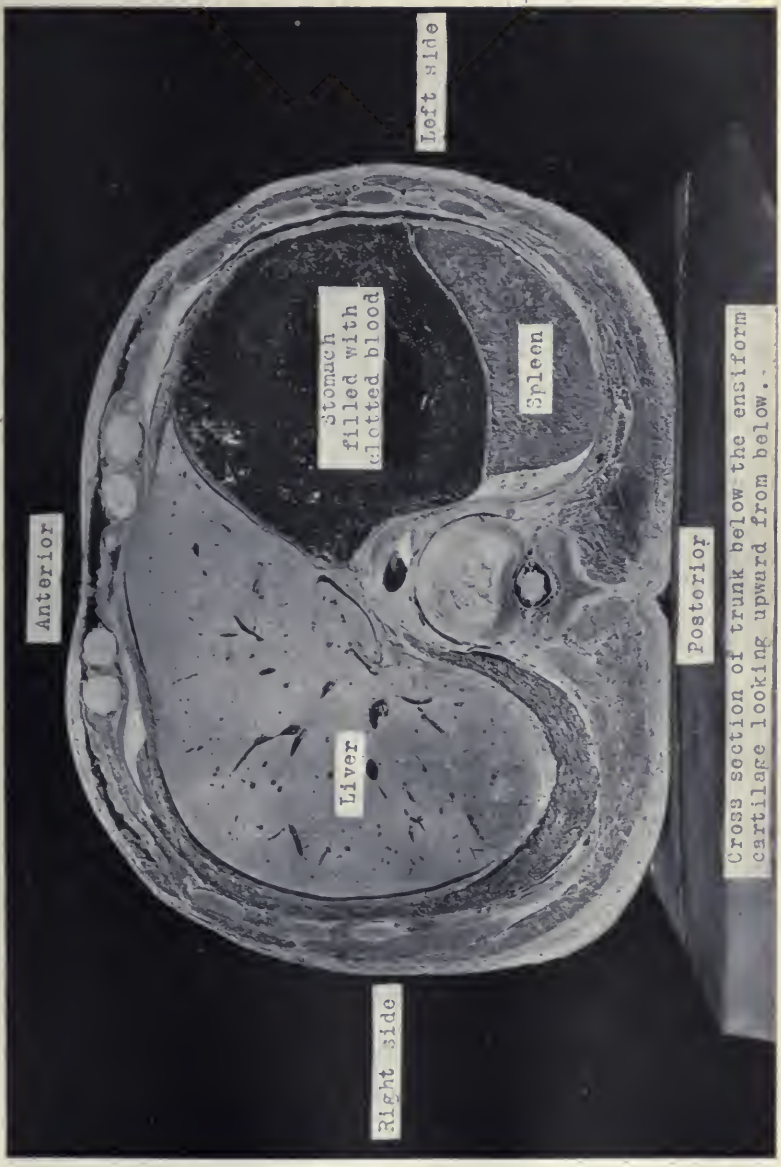
Anterior
Left side
Stomach
filled with
clotted blood
Spleen
Liver
Posterior
Right side
Cross section of trunk below the ensiform
cartilage looking upward from below.

Fig. 143.

the cause of death to be due to perforation into the esophagus with profuse bleeding into the stomach and intestines.

It is not my purpose to discuss with you the diagnosis of aortic aneurysm, except to state that unless you keep its possibility constantly in mind you will miss it many times. It has been said that nothing is more conducive to clinical humility than aortic aneurysm, certainly the autopsy table reveals its great frequency, and in recent years this has been emphasized again by the *x*-ray studies of the chest. In every adult complaining of persisting pain in the chest, either anteriorly or posteriorly, particularly men over thirty years with a past history of syphilis, the possibility of aortic aneurysm must be kept in mind. Autopsy figures reveal the frequency of the disease which clinically is not demonstrable by physical signs, at least by but few physical signs, such as slight increase in the manubrial dulness, etc. The "latent" types, those with a few symptoms or signs, are not an infrequent cause of sudden death. If we expect to find the classical text-book symptoms and signs we will miss most of the cases of aneurysm. It is the partially developed types, those with a few symptoms and no signs, or a few signs and no symptoms, which form the great group of cases. The "aneurysm of symptoms," rather than the "aneurysm of signs," is the type we overlook.

I want to call your attention to a sign which was present in our patient and which ought to be sought for in all patients in whom a deep-seated aneurysm is suspected. The sign was described by Surgeon-Major Oliver, and is spoken of as tracheal tugging. It is elicited, in the words of Dr. Oliver, as follows: "Place the patient in the erect position, and direct him to close his mouth and elevate his chin to almost the full extent; then grasp the cricoid cartilage between the finger and thumb, and use steady and gentle upward pressure on it, when, if dilatation or aneurysm exists, the pulsation of the aorta will be distinctly felt transmitted through the trachea to the hand." The elevation of the chin is not necessary and it may sometimes be elicited more easily with the chin down. Tracheal tugging is due to the transmission of the pulsations of the aortic aneurysm as a result

of compression of the left bronchus, or as a result of adhesions between the sac and the trachea or bronchi. It is not pathognomonic, inasmuch as it has been found in simple dilatation of the aorta and in mediastinal growths.

The cause of death in patients with thoracic aneurysm is due to rupture in at least one-half of the cases. The structures involved in the rupture were studied by Lemann, who found among 592 collected cases the following order of frequency: pericardium alone, 148; left bronchus, pleura, or lung, 160; right bronchus, pleura, or lung, 62; esophagus, 50; trachea, 48; superior vena cava, 31; pulmonary artery, 18; other structures, 40. The relative frequency of rupture into the esophagus, as in our patient, is variously stated by different writers, thus among almost 600 cases collected or reported by Borowsky, Cush, Huchard, Charcov, Oswald, Browne, Kelynod, Hall, and Biggs, it occurred 50 times, varying with the individual writer from 1 in 7, as reported by Hall, to 1 in 24, as reported by Biggs.

Finally, before we pass on to the discussion of our next patient, I wish to emphasize to you again the relationship which syphilis bears to cardiovascular disease. As in our patient, so in all patients, syphilis as a predisposing factor to aneurysm holds first place. And not only is this important in the etiology of aneurysm but also in the etiology of cardiovascular diseases in general. In every old case of syphilis the aorta when examined microscopically shows characteristic syphilitic infiltration of the media and adventitia—changes which may not be visible to the naked eye. In the early stages of syphilis, as Warthin has demonstrated, slight or no changes are evident microscopically, and yet the characteristic lesions with spirochetes are demonstrable microscopically. The microscopic picture is that of "small infiltrations of lymphocytes and plasma cells along the vasa vasorum of the media and adventitia, usually most marked around the vessels of the latter, and diminishing in degree as the vessel passes up into the media. Perivascular proliferation, fibrosis, and obliteration of the small vessels then follow. The resulting disturbances of nutrition of the vessel wall are first seen in the intima and the inner portion of the media, in the form

of fatty degeneration, atrophy, and necrosis of the cells of this portion of the vessel, with weakening and thinning of the wall, followed later by fibrosis and hyaline change. The involvement of the media progresses steadily outward, and because of the greater involvement of the media locally there results local thinning of the vessel wall and microscopic ruptures of the elastic fibers. Such changes predispose to the development of aneurysms" (Warthin).

TUBERCULOSIS AND PREGNANCY[1]

Brief Records of 5 Patients. Discussion. The Influence of Pregnancy on Tuberculosis. The Influence of Tuberculosis on Pregnancy. Conclusions as to the Treatment of Pregnancy in a Tuberculous Patient. Care of the Child.

THE attitude which physicians should take in advising a tuberculous patient who has become pregnant depends so much upon the consideration of the individual patient that it is difficult to formulate any definite rules of action. Our conception of the relationship of these two conditions and our plan of action are illustrated by the case records of the following patients:

CASE I (G-4028).—A. W., aged twenty-seven years, admitted to the Jefferson Hospital Department for Diseases of the Chest January 10, 1917.

Family History.—Negative.

Personal History.—Married five and a half years. Two children living and well.

Present Illness.—In April, 1916 (about nine months ago), when patient was four months pregnant, she noticed that she was losing in weight and strength and had a slight cough, for which she consulted a physician, who said she had bronchitis. After the baby was born (five months ago) she became rapidly worse, with aggravation of cough and expectoration, with the addition of chilliness, fever, and night-sweats.

Physical examination upon admission revealed advanced bilateral tuberculosis of the lungs, with cavity formation. Temperature 101° to 103° F. in the afternoons, with chilliness and sweats. The sputum showed many tubercle bacilli.

[1] A reference to the more important articles in the literature may be found in the author's article on the Relationship of Tuberculosis and Pregnancy which appeared in the Therapeutic Gazette March 15, 1915. An excellent reference with regard to the treatment of these patients is that by Norris and Landis, Fourteenth Report of the Henry Phipps Institute, 1918.

Progress and Comment.—The patient became progressively worse, and died three months after admission, or eight months after delivery. The history is clearly that of onset of symptoms of tuberculosis during pregnancy, with rapid decline after delivery.

CASE II (G-2029).—F. T., aged twenty years; admitted to the Jefferson Hospital Department for Diseases of the Chest September 23, 1916.

Family and *previous personal histories* contain nothing noteworthy. Married when seventeen years old; has one child seventeen months old.

Present Illness.—Eighteen months ago, during the latter months of pregnancy, she began to cough, expectorate, and lose weight. Shortly after delivery she recovered to some extent, the cough lessened, and she gained in weight. She was definitely improving with regard to the pulmonary lesion, and was advised against conception, at least until such future time as it could be done with reasonable safety. In spite of this advice she became pregnant, and now at five months has a return of the cough, expectoration, and fever. She has lost about 30 pounds in weight and four days ago she had a small pulmonary hemorrhage.

Physical examination revealed moderately advanced and active bilateral tuberculosis of the lungs. The sputum contains many tubercle bacilli.

Progress and Comment.—The patient was placed under observation for one week. Because of the acuteness and advanced stage of the tuberculous lesion, and the advanced stage of the pregnancy, it was deemed inadvisable to interfere. The patient died six weeks after admission. A study of the patient's history emphasizes the need of warning against conception in one who has had a recent pulmonary lesion, as this woman had, and the dire results with which failure to abide by this advice is fraught. The first pregnancy activated, in all probability, an old latent tuberculous lesion. Following delivery there was definite evidence that the disease was tending to subside, when the second pregnancy intervened, causing an exacerbation of the tuberculous disease, resulting in death during pregnancy.

CASE III (G-10844).—D. B., aged twenty-four years; ad-

mitted to the Jefferson Hospital Department for Diseases of the Chest September 25, 1917.

Family History.—One brother died of tuberculosis.

Personal History.—Married three years ago. One child living and well. At the present time five months pregnant.

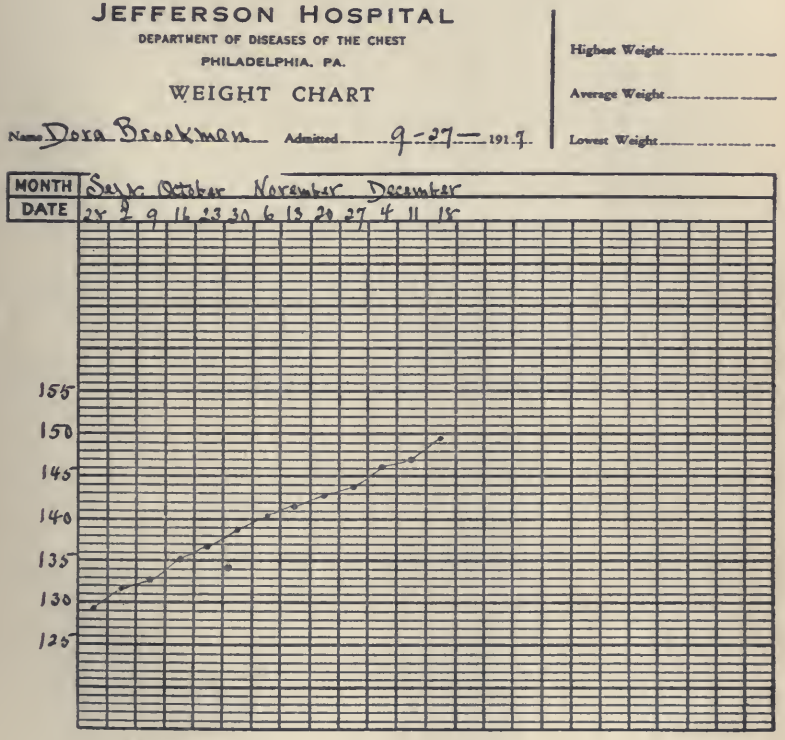

Fig. 144.

Present Illness.—Two months ago began to cough, which has continued to the present time, with expectoration and loss of 13 pounds in weight.

Physical examination revealed bilateral pulmonary tuberculosis, with most marked involvement on the right side, where below the right clavicle tubular breathing, whispering pectoriloquy, and scattered crackling râles suggested considerable involve-

ment and activity. The sputum was positive for tubercle bacilli. The patient, however, stated that she had a good appetite and felt fairly well, except for the cough. She had no fever.

Progress and Comment.—We decided, in view of the fact that the patient was fairly well along in her pregnancy, and because of the chronic nature of the tuberculous lesion, to place her under observation and be guided by the subsequent course as to whether we would or would not terminate pregnancy. We soon found that in spite of what seemed to be alarming physical signs, she gained progressively in weight (Fig. 144) and remained absolutely afebrile, and although the cough persisted, she improved so much that we were able to take her to term in better condition than when she came under observation. She was delivered of a healthy baby, and at the present writing, about one year afterward, she is, to all intent and purposes, an arrested case, and with a regulated life is useful in the care of her home.

CASE IV (G-2065).—R. B., aged eighteen years, admitted to the Jefferson Hospital Department for Diseases of the Chest November 8, 1916.

Family History.—Negative.

Personal History.—Married nine months ago. At the present time not quite four months pregnant.

Present Illness.—Two months ago began to cough and expectorate and lose weight.

Physical examination revealed early active and bilateral pulmonary tuberculosis. Sputum showed many tubercle bacilli.

Progress and Comment.—The termination of pregnancy was advised and done under the skilful attention of an experienced obstetrician. One month following the delivery the cough and expectoration lessened, and at the present time, two years later, she is in excellent condition.

CASE V (G-10896).—F. C., aged nineteen years; admitted to the Jefferson Hospital Department for Diseases of the Chest November 29, 1917.

Family History.—Negative.

Personal History.—Married four years; one child living and well. At the present time seven months pregnant.

Present Illness.—Two months ago began to cough, expectorate, and lose weight, and had horseness at times. Slight fever.

Physical examination revealed limited bilateral pulmonary tuberculosis, with a few crackling râles. Sputum positive for tubercle bacilli.

Progress and Comment.—Under observation and with rest and hygienic dietetic care the lesion in the lung seemed to be progressing. After consultation, the obstetrician decided to induce labor prematurely. This was done, and a living child secured. The activity of the disease in the mother promptly subsided, and at the present writing, one year afterward, both the mother and child are doing very well.

Discussion.—The association of tuberculosis and pregnancy is not uncommon; in fact, among every group of married tuberculous women, the history is frequently obtained that the tuberculosis manifested itself for the first time during or following a recent pregnancy. Among 200 married women with pulmonary tuberculosis admitted to our wards during the past five years approximately 30 per cent. gave this history. It is entirely probable that many of the patients included in this percentage were actively tuberculous before conception, and the occurrence of pregnancy intensified the process to such an extent as to call attention to the disease which had hitherto been unrecognized. It is fairly generally conceded that tuberculosis is a childhood infection and that its clinical manifestation in adult life, oftentimes many years afterward, is a result of some factor or factors which reduce the general or local resistance.

According to postmortem evidence and the tuberculin test it has been shown that practically all those who have reached fourteen years of age have been infected. The occurrence of tuberculous manifestations in later years results from a local or general lowering of the tissue resistance. In view of the great frequency of early tuberculous infection, and the vast number of subsequent pregnancies, it would seem unwarranted to assume that pregnancy alone is the factor which "lights up" the old latent infection. On the other hand, it is warranted to believe that a semiquiescent or slightly active lesion in one of lowered

resistance, in whom the warfare between the body forces and the infection is being carried on in the balance, might be definitely and unfavorably influenced by the increased demands made upon the body by pregnancy and labor. It is to be remembered that our wards contain the poor and hard working of the community, and for this reason the percentage may be higher than among the better class, as among poorer patients illness oftentimes does not make them consult a physician until there are marked symptoms or physical disability, and when these occur in pulmonary tuberculosis the disease is, as a rule, advanced. The date of onset as given by the patient is usually that of active tuberculous manifestations beyond the early stage.

The frequency of deaths from tuberculosis among women of the child-bearing age is very high. Bacon estimated, for example, that in the United States, yearly, 44,000 to 48,000 women of the child-bearing age die of tuberculosis, and that gravidæ and puerperæ furnish one-fourth of all the deaths from tuberculosis in women of this period of life.

The *problem* which I want to discuss with you today is our attitude toward the pregnancy. It is not how to treat the tuberculosis, because that is carried out along established lines, in or out of a sanatorium, as the conditions warrant. There is a difference of opinion with regard to our attitude toward the pregnancy, and our action will depend upon our conception of (1) the influence of pregnancy on tuberculosis and (2) the influence of tuberculosis on pregnancy. Let us consider briefly these factors.

INFLUENCE OF PREGNANCY ON TUBERCULOSIS

As previously stated, 30 per cent. of our married women patients dated the onset of their symptoms to a recent pregnancy or parturition. Various other observers have noted the large proportion of cases dating lung trouble to a pregnancy. Thus Jacob and Pannwitz found 25 per cent.; Fishberg, 37.4 per cent.; Maragliano, 59 per cent., and Trembley, 63 per cent. of the cases under their observation. A distinct aggravation of the disease was noted during pregnancy in 64 per cent. of cases studied by Diebel; 66 per cent., by Kaminer; 50 per cent., by Merletti, and

70 per cent., by Von Rosthorn. The course of the disease is usually progressive following parturition, and Bacon states that "one-third of the pregnant tuberculous women die within a year of their labor." There are a few observers who have had a different experience: thus Rabnow and Reicher report that 7 of 10 working women under treatment for active tuberculosis passed through pregnancy without signs of aggravation of the disease. Cohn reports 53 of 58 cases apparently uninfluenced by gestation; and Kohne thought the lung condition improved in 16 of 22 cases. These observers, however, are in the minority, and the majority of authorities are of the opinion that although a few cases of pregnancy and labor may seem to be without influence on the disease, nevertheless in the vast majority of instances the effect is distinctly unfavorable. A few isolated cases may seem to improve or be uninfluenced by pregnancy, only to rapidly decline during the periods of gravest danger; namely, labor and the lying-in period. It is important, therefore, in considering the influence of pregnancy to include not only the period of gestation but also the inevitable termination, parturition, puerperium, and lactation. The physical exertion, loss of blood, exhaustion of labor, and the occurrence of lactation, not to mention the demands made in abnormal cases, call upon the reserve of the patient, who in the presence of an active tuberculous infection is little able to respond without adversely affecting the pathologic process. Another danger to be reckoned with is that of auto-infection by aspiration of infected material from an old focus in the lung into healthy portions as a result of the violent respiratory movements during labor. Hanau pointed out this fact in 1887 in autopsies on tuberculous women who died soon after labor. He demonstrated, in addition to the old pulmonary lesions, new depositions of tubercles, which apparently could be explained only on this basis. The effects of parturition, therefore, are to be reckoned with in many instances more seriously than the effects of pregnancy. The latter assumes greatest importance when associated with nasuea and vomiting, toxemia, or any abnormality. The view of the profession in the past, as expressed by Dr. Edward Warren in his prize essay of

1857, is no longer tenable. Dr. Warren wrote in part that "pregnancy, coition, etc., are particularly desired by women affected with phthisis, which constitutes a pointing of nature toward a remedy for the evils by which the system has been invaded."

INFLUENCE OF TUBERCULOSIS ON PREGNANCY

A history of sterility is uncommon in patients with pulmonary tuberculosis; indeed, it is a well-known fact that conception occurs frequently in patients with advanced disease. Marked anemia and marked general debility of an advancing lesion militate against conception, but in early cases its occurrence is rarely restricted. Among 100 of our married tuberculous women, 10 had never been pregnant. Of this number, one patient had been married only four months, and the effort was made to prevent conception, and one patient was operated upon four years prior to marriage for bilateral tubo-ovarian abscess. The husbands of the remaining 8 are said to be in good health, and, unfortunately, we have been unable to examine them with regard to their lung condition or their part in the childless marriages. The average duration of married life in this group of non-pregnant females was 10.6 years. It is interesting to note that in one of them, aged thirty-nine, and married at twenty-eight, the onset of the disease is dated from an operation performed under ether anesthesia one year ago for the correction of the existing sterility. Among the remaining 90 cases the average number of pregnancies was 4.7 per patient. Miscarriages occurred in 17 patients (18.8 per cent.) from one to four times, or computed upon the total number of conceptions, in 7.4 per cent. of the pregnancies. In 3 of the 17 patients the onset of the tuberculous manifestations was directly referred to a spontaneous abortion (ten weeks, one and a half years, and six years ago). In one instance of pregnancy terminated prematurely three times in succession, tuberculous manifestations occurring for the first time during first pregnancy, and becoming aggravated during and following each gestation. Among the remaining 13 the miscarriages antedate the onset of tuberculosis. May some of these miscarriages,

otherwise unaccountable, result from the toxemia of an early tuberculous lesion? Excessive coughing, progressing anemia, and high fever may be potent factors in causing abortion in some cases.

CONCLUSIONS AS TO THE ADVICE TO BE GIVEN A TUBERCULOUS WOMAN

It is our belief that the tuberculous woman should be advised against marriage and conception unless the lesion has, to all intent and purposes, been cured; that is, if the patient has been free from local and constitutional symptoms for a period of two or three years under ordinary conditions of life. If conception occurs our attitude with regard to it depends (1) upon the activity of the tuberculous lesion and (2) the stage of the pregnancy.

If the tuberculous lesion is early and active the pregnancy should be terminated if it has not gone beyond four and a half months. In such a case one should obtain the combined views of a chest specialist as to what constitutes an active or menacing lesion, and of the obstetrician as to the possible influence on the general condition of the patient by the termination of pregnancy. Unless the emptying of the uterus is deemed immediately imperative the safe precautionary method is to place the patient in bed, study the temperature and pulse, and observe closely the symptoms of pulmonary activity. If it is found that the lesion is active or threatens to become active the uterus should be emptied at once by a skilled obstetrician with as little trauma and shock as possible. The question of the anesthetic is to be decided by the operator, but it is the opinion of the writer that ether should be prohibited.

If the tuberculous lesion is early and inactive, for example, in a patient who gives a previous history of having undergone sanatorium care, but in whom the signs and symptoms are those of an arrested or cured case, the pregnancy should be left alone, particularly if, in spite of previous advice as to preventing conception, it had been disregarded. The patient ought to be placed under the best hygienic care, and a schedule of rest, ex-

ercise, and diet, with an abundance of fresh air, prescribed. If in doubt as to the inactivity of the lesion, the patient should be placed under close observation of the temperature, etc., as described in the previous paragraph. If under the best conditions the tuberculous lesion threatens to become active, the pregnancy should be terminated. An early inactive case, however, should be left entirely alone.

If the tuberculous lesion is early and active, and the pregnancy beyond the midperiod, we agree with Norris and Landis that little is to be gained by emptying the uterus, and it is best to allow these patients to go to, or nearly to, term, at which time labor should be made as easy as possible and special care directed to the patient during the puerperium, which is perhaps the most menacing time. Because the lesion is early it is often possible to gain considerable ground by placing the patient under immediate hygienic dietetic care. If not, the lesion may be kept fairly well under control till pregnancy is terminated prematurely. If the tuberculosis is so acute that the termination of pregnancy would seem immediately necessary, the chances are that such a termination will not help an already overwhelming lesion. In most instances such a patient will come to an untimely end, irrespective of operation.

If the tuberculous lesion is far advanced and the pregnancy likewise, a watchful waiting is all that is indicated.

THE CARE OF THE CHILD

If the pregnancy has been allowed to go to term, it will be found that unless the disease of the mother is far advanced children are frequently quite healthy at birth. Congenital tuberculosis is exceptional, and while various observers have reported instances of apparently transplacental infection, we must regard such infection as uncommon. The postnatal influence of tuberculosis in the mother is probably of greater moment to the child, because it intimately concerns the two essentials of its welfare: (1) proper nutrition and (2) wholesome environment. The first of these brings up the question of our attitude regarding nursing the child. Nursing in a tuberculous woman is

a menace both to the woman and to the child. Lactation is a demand upon the mother's nutritive reserve which is so necessary in the active combating of the disease. The abstraction of lime salts, so valuable in the pathologic process, occurs both during pregnancy and lactation (Lobstine). Nursing should be prohibited and, if possible, a healthy wet-nurse substituted or artificial feeding instituted. With regard to the child, it may seem undesirable to pursue this course, in view of the fact that the milk of tuberculous women rarely contains tubercle bacilli. However, there is a distinct danger of infection from other sources in the mother, a danger which is greater than one would suppose upon first thought. The soiling of the mother's hands with infective material from the mouth, the soiling of the breast in handling, etc., open many avenues for infection of the child; in fact, the way to reduce this danger to a minimum—the ideal way—would be to separate mother and child from ordinary contact. This may seem an exaggerated refinement, but it should be recalled that many have had the experience of Armand-Delille, who found in investigating the fate of the children of tuberculous families that among 787 children in 175 families, the 323 placed in the country by the Child Preservation Society are all well; of the 396 not helped by the society, 238 developed tuberculosis (over 60 per cent.).

Langstein states that children in the first and second years of life are from eight to nine times more liable to tuberculosis than adults. He quotes Pollack, who found among 285 children from families containing patients with open tuberculosis, 275 children with a positive tuberculous reaction. In this group of children it was found that clinical tuberculosis existed most frequently when exposure existed from birth; thus, among the 57 who were first brought into contact in the third year of life, only 7 showed clinical tuberculosis; among the 61 who were exposed in the second and third years, 45 showed clinical tuberculosis, with 7 deaths; and among the 207 who had been exposed to infection since birth, 200 showed clinical tuberculosis, with 21 deaths. The elimination of contact infection in infancy is one of the important problems of the antituberculosis crusade.

CLINIC OF DR. MARTIN E. REHFUSS

JEFFERSON HOSPITAL

MEDICAL TREATMENT OF BILIARY AFFECTIONS

WITHIN the last five years the medical treatment of biliary affections has undergone an important change. This change consists in a transition from systemic to local treatment; from empirical to specific treatment based on the newer anatomic and pathologic conceptions of biliary disease. The first concept which must enter our minds is the fact that the biliary tract,

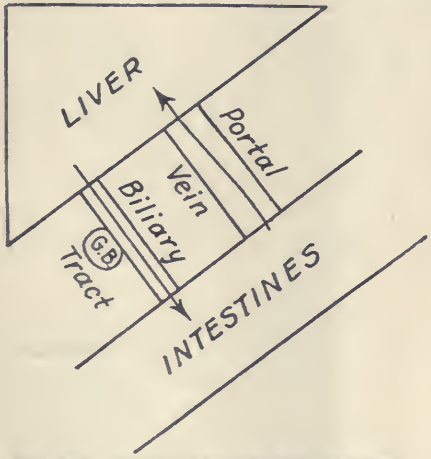

Fig. 145.—Intestinal hepatobiliary system.

the gall-bladder included, represents the connecting link between the liver and the intestines. In fact, in a broad way we have an afferent and an efferent system between these two units. The portal system represents the afferent system, transmitting the material from the intestinal laboratories to the complicated laboratory situated in the liver. The latter plant, apart from

its other functions, prepares the bile and sends it back to the intestine by means of the efferent tract. This conception emphasizes the importance of both hepatic and intestinal action in the production of biliary pathology. It becomes immediately evident that infection of the biliary passages, apart from the hematogenous infections, must take place either (1) by hema-

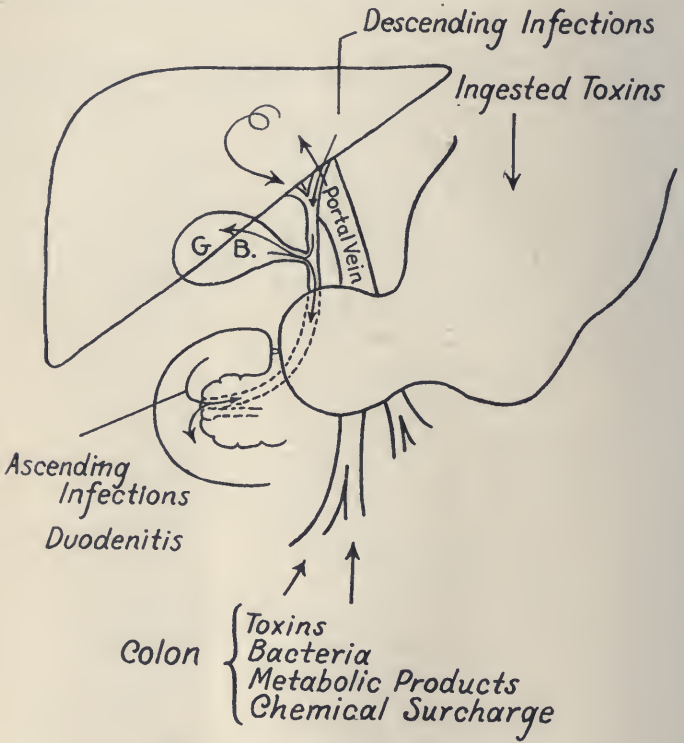

Fig. 146.—Methods of biliary infection.

togenous infection from foci elsewhere, (2) from ascending infection (from the intestines), (3) descending infection from the liver. The possibilities of alteration in the chemical composition of the bile as well as its bacteriologic contents are only becoming manifest as this subject is being more thoroughly investigated. Two points stand out clearly: first, that there are distinct alterations in the chemical composition and viscosity of

the bile, such as the increase in the cholesterol content favoring cholelithiasis, and alterations in the pigments, salts, the urobilin, and urobilinogen, as well as the calcium salts, the exact significance of which are not as yet fully known. On the other hand, the presence of pathogenic organisms and particularly the elimination of organisms of the typhoid colon group is assuming increased importance as newer studies indicate its frequency. *We are gradually working around to the idea that there is not merely an elective localization of pathogenic organisms, but, as Richet pointed out, there is also an elective elimination of these same elements.* If organisms of the dysentery group are eliminated by the large bowel after injection into the blood-stream, it is equally true that organisms of the group mentioned above are most frequently eliminated by the hepatobiliary tract.

On the other hand, the association of duodenitis, concerning which we are obtaining more and more information, and more often gastro-duodeno-enteritis, makes it probable that ascending infection is not rare despite the fact that there is at times a positive pressure in the gall-ducts. These conceptions introduce as factors in biliary disease nearly the whole gamut of hepatic and duodenal conditions. This is consistent with the fact that many advanced hepatic disturbances are unaccompanied by evident biliary change, the inference being that the bacterial or chemical alteration is not sufficient to induce demonstrable change.

The mechanism of infection demands some mention in these conditons. Certainly the most common infecting organisms are the colon bacillus, streptococcus and staphylococcus, and the pneumococcus. It is probable (1) that the three last mentioned organisms are usually hematogenous, and the first represents the type most frequently in association with obvious intestinal disturbances; (2) many diseases are essentially polyvalent in their bacteriology, as, for instance, the association of the influenza bacillus, streptococcus, and pneumococcus in the recent epidemic of grip, and the association of the streptococcus in many cases of pneumonia. These polyvalent infections are frequently accompanied by the implantation of one or more

organisms showing an elective affinity for this region; (3) the alteration in virulence of chronically infecting organisms producing the association of appendicitis and cholecystitis along the lines laid down by Rosenow.

I would mention a new factor which to my knowledge has not been emphasized, but which from my observations occurs with great frequency. I refer to the associaton of intestinal stasis and a definite deviation from normal in these cases. The action of intestinal stasis is far from completely understood. It is not simple stasis, with the absorption of toxic products. but far more important are the changes in intestinal rhythm which follow this advent. Aërophagia, heart-burn, globus, coated tongue are not merely symptoms attending intestinal stasis, but symptoms produced by a mechanism which Alvarez has referred to as "mid reversed peristalsis." *There is no principle recently enunciated in gastro-intestinal pathology which is more important than the various modifications of reversed peristalsis.* Our studies in the Jefferson College on the mechanism of duodenal regurgitation were but a small amount of the evidence accumulating in our sight to suggest the ready manner in which normal continuity and rhythm can be markedly changed. It is probable in every case of high intestinal stasis that a definite degree, more or less marked, of reverse peristalsis occurs, resulting in the regurgitation of jejunal and ileal contents back toward the duodenum. In fact, in almost 80 per cent. of all biliary cultures taken by us according to the method mentioned, the colon bacillus was found (a possible explanation to me being mild reverse peristalsis with implantation of the colon bacillus high in the small bowel). This is not normal, inasmuch as we encountered negative cultures with sufficient frequency, but the above figures were obtained in diseased conditions. One explanation is the elimination of the colon bacilli, the other is the mechanism mentioned above. I have repeatedly demonstrated that relief of high intestinal stasis through high intestinal irrigation results in a disappearance of the symptoms.

Recent anatomic and physiologic studies support the contention of Meltzer that there is a mechanism of contrary innerva-

tion similar to the urinary bladder in which the smooth muscle of the gall-bladder and the Oddi muscle at the termination of the common bile-duct play the reciprocal parts, contraction of one resulting in dilatation of the other, so that when the Oddi sphincter is contracted and the gall-bladder relaxed the organ fills up, and vice versa. The efficiency and rhythmicity of this function depends on its efferent stimuli, balanced dietaries and regular eating producing regular and complete evacuation, irregularities in eating resulting in undue stasis of bile.

It therefore follows that, apart from neoplasm and contiguous diseases, disease of the biliary passages arise from three sources: the blood-stream, the lymphatic stream, and the bile, and the bile undergoes three separate forms of alteration: infection, stasis, and alteration in its chemical constituents. Infection takes place through the blood-stream, the lymphatic channels, ascending from the bowel and descending from the liver.

DIAGNOSIS OF BILIARY DISEASE

In the diagnosis of biliary disease the internist is armed with a new and valuable procedure in the shape of duodenal intubation. In this way the bile can be studied directly as is the gastric secretion, and the various forms of chemical analysis can be applied to the material removed. In other words, we can make an examination of the bile from the standpoint of its chemical constituents, namely, cholesterol, bile-pigments, and salts, urobilin and urobilinogen, calcium content, as well as the determination of viscosity; from the microscopic examination the presence of mucus, pus, blood, and laminated cholesterol plates; and from the bacteriologic examination the determination of the presence of pathogenic bacteria. Inasmuch as all these procedures depend for their determination on an accurate method for obtaining bile, the following details are given: the patient is examined the first thing in the morning upon an empty stomach. After preliminary rinsing of the mouth with some antiseptic solution, the long, fractional gastroduodenal tube is passed, according to the ordinary technic, for 70 cm. or more. Ordinarily I pass a length of tubing sufficient to go from the

mouth, externally, to the anterior superior spine of the ileum. The tube is usually passed with the aid of beef-broth or bouillon which has been sterilized by boiling. If the broth is given at the same time that the tube is swallowed the passage of the instrument is materially facilitated. Occasionally the tube will be found to enter the stomach more readily after milk is ingested, the digestion of the curds apparently favoring the passage of the tip. As soon as the tube is introduced the patient is turned on his right side with the left leg drawn up and thrown over the right in order that the pelvis be definitely rotated in that direction. The lapse of time before the tip enters the duodenum varies with every individual; in fact, there is no method by which we can predict the duration of time necessary to intervene before bile is obtained. The bile is readily recognized by its appearance, and it will be noticed that the flow is intermittent. In obtaining bile cultures the following procedure is the one which has recommended itself to us: after the bile is obtained the patient is put in the fully recumbent position with the head directed toward the edge of the bed, the remaining 2 feet or more of tubing is allowed to remain suspended over the side of the bed in such a way that by siphon action there will be a tendency toward a steady flow of bile. After the flow has commenced and the first part is thrown away, three culture-tubes are used in the following way; the first tube is placed under the drip without allowing the tube to come in contact with the fractional tube, and after the first culture of bile is obtained the second culture-tube is used in the same way, followed, in turn, by the third. This method has its advantages and its disadvantages, which are readily apparent even upon superficial observation. The disadvantages are the following: it is difficult to maintain the sterility of the tube owing to the fact that its transit into the duodenum must necessarily lead through organs which can be only incompletely sterilized; second, the bile is not usually obtained in a pure state, being associated with the pancreatic secretion, the succus entericus, and not infrequently some of the gastric contents. This means that infection in this region can be also ascribed to a duodenitis.

On the other hand, the following points can be claimed for the method: after the initial flow of bile the material obtained is remarkably uniform, as are the resulting cultures. It therefore follows that external contamination will not give a uniform appearance in the various culture-tubes. Accidental contamination is recognized by the presence of isolated colonies and the lack of uniformity in the appearance of the three culture-tubes. A true bile infection is recognized by the fact that all three tubes have practically the same aspect and contain the same bacteria. We know of no way by which organisms coming from pancreatic secretion can be dissociated from those seen in the bile, and for diagnostic and therapeutic purposes there is no pressing need for such a differentiation. We have encountered the streptococcus and pneumococcus only infrequently; the colon bacillus, however, was far more apparent. Any form of media can be used. As routine procedures we employ blood-serum, agar, and bouillon. The vaccines are made in the ordinary way. The frequency of the colon bacillus has not yet been satisfactorily explained, whether it represents a form of elimination on the part of the liver into the bile; whether its presence is due to reverse peristalsis from the small bowel, as seen in the ascending or cecal type of constipation; or whether it represents a true infection, we are not prepared to state. Certainly the presence of abundant colon colonies is not a phenomenon of normal bile, nor is their presence in the upper duodenum to be associated with perfect health.

THERAPY OF BILIARY DISEASE

In a study of the therapy of biliary disease the following means are at our disposal:

Specific treatment can only be used in the presence of specific etiology. Vaccines constitute a specific form of therapy if we have isolated the causative organism or organisms. The above method offers us this possibility, and in every case culture of the bile should be carried out with the idea of preparing vaccines. Of great interest is the communication of Bertholet on the

method of isolation of intestinal organisms by means of amino-acid media. This whole subject, however, is too recent to mention in gall-bladder work. Kelly (Stitt), in a bacteriologic study of 413 operations on the biliary tract by Deaver, found the bile sterile in about one-half the cases, but in acute disease pathogenic organisms were almost constantly present. Bacillus coli was found in 30 per cent., Bacillus typhosus in 7 per cent., Staphylococcus pyogenes in 2.9 per cent., streptococcus in 0.2 per cent.; 55 per cent. were sterile. By the method which we use the percentage of positive cultures is higher, but the relative incidence of other organisms about the same. Stitt mentions that in one case of cholecystitis the colon bacillus found was markedly hemolytic on blood-agar plates. There is no question but what there is a marked difference in the virulence and pathogenic properties of various colon organisms, and also a fact which I have noted, namely, that an autogenous vaccine from the colon bacillus isolated from the bile gave in one case of mine much more pronounced reactions than the same organism isolated from the feces (arthritis deformans). These differences make us hesitate to say whether a colon growth is due to colon organisms normally eliminated through the liver, or whether it is due to infection of this region. As I have already pointed out, the cultures are taken by the drip or siphon method; in order that an organism be used, it must either occur in pure culture or in sufficient frequency on all of the three tubes to be used as a vaccine.

We begin with usually 25,000,000 of the Bacillus coli, 100,000,000 of the ordinary pus organisms. Occasionally unusual organisms are encountered. For instance, on three occasions (three separate examinations) we encountered in pure culture in each instance in an old case of angiocholitis, repeatedly operated on and complicated by many adhesions, the Bacillus pyocyaneous. In several instances we got a pure growth of the pneumococcus. The streptococcus, according to my studies, is very rare, although I have frequently used blood-serum. Sensitized vaccines are undoubtedly of value, but I have not used them in this work.

The following points are of value in this work:

(1) Nearly always the patient with gall-bladder or duct disease has foci of infection elsewhere. We therefore culture the nose, throat, teeth, frequently the urine, and when a definite strain is located in the gall-bladder, we make a polyvalent vaccine consisting of not merely the organism isolated from the bile, but the same organism found elsewhere. A difference in virulence undoubtedly occurs, as mentioned above, and this method contributes to the likelihood of an effective antigen.

(2) Autogenous vaccines are to be preferred to stock vaccines, but the presence of organisms elsewhere which are persistent and suspicious in the mind of the clinician ought to be included. I believe that the good results I have obtained have almost always been due to this precaution. Only rarely do we give the single organism.

(3) Small, frequently repeated, and increasing doses are given until a definite reaction is obtained. Strong reactions are to be avoided, although some of the best results that I have obtained have been following a strong reaction with active temperature rise, and severe general reaction. In general, however, only those vaccines do good which give a reaction, but a dose should be used which provokes only a slight reaction. A strong reaction means reduce the next dose. In fact, there is no rule as to the amount of vaccine. If about four steadily increasing injections are given without reaction, the vaccine treatment is discarded. In some cases there is a distinct reduction in the virulence or growth ability of the organism without their disappearance, a point which I have noted on several occasions.

(4) Occasionally definite organisms are found, vaccine prepared and given, but, in spite of reactions, no improvement occurs. The following is such a case:

Mrs. H. Subicterus, bile in urine, tender gall-bladder; repeated attacks pronounced intestinal stasis and general ptosis. Cultures gave pronounced growth of colon and Staphylococcus pyogenes on three successive occasions. This patient received cautiously vaccines (autogenous), with no improvement. Operation disclosed stone in common duct and in gall-bladder and

chronic cholecystitis and angiocholitis. The gall-bladder when opened gave the characteristic indol odor of the colon organism. Here vaccine therapy naturally failed to induce a change, owing to the fact that it did not reach the active foci contained in the stones. It is questionable likewise whether vaccine therapy alters the ability of bile to maintain living colon organisms.

A second case represents a different phase of this problem. A. I., a young girl, had six operations on the gall-ducts by various surgeons in an attempt to relieve the pain and infection. Each operation made the duct more difficult to find, and on each occasion many adhesions were demonstrated. This is the case with the pure culture of the Bacillus pyocyaneus, and vaccines failed to relieve her in the slightest. It is probable that avascular tissues like scar tissue may harbor infection and prevent the full influence of immune bodies circulating in the area in response to vaccine injection.

The first of these two cases indicates the difficulty of dealing with a cholelithiasis and cholecystitis case. Almost always these cases are surgical, but the problem which the surgeon has failed to answer for us is the following: *Does drainage with or without cholecystectomy result in cure of the infection?* While it is true that numberless cases attest to the value of the operative procedure, it is equally true that in many cases a persistent angiocholitis follows. The following are cases of this description cured by vaccine therapy:

Mrs. C., mother of two children. Operated on for cholelithiasis and cholecystitis; the gall-bladder was removed. A year later there were still symptoms, and culture revealed both colon and staphylococcus. A mixed vaccine, with organisms from the throat containing staphylococcus, streptococcus, and colon, was given. At the time this treatment was commenced the patient was jaundiced. She received both local treatment, by means of the Murphy drip, and duodenal tube and vaccine and dietetic treatment, with a total disappearance of all symptoms.

Mrs. L. Operated on for gall-stones, had persistent tenderness, and symptoms referable to the gall-bladder region. A pure colon culture was obtained. This, together with organisms

from the mouth and throat (staphylococcus and streptococcus), was used. After eight injections, diet, and treatment of the bowel all symptoms disappeared.

These cases are illustrative of a series which on some future occasion I hope to assemble, but on their findings I base my belief that in the absence of many adhesions or stone vaccine therapy is of value in demonstrated infections of this tract.

Dietetic Treatment.—Best known among the forms of dietetic treatment for diseases of the biliary tract is the so-called low cholesterol diet in cholelithiasis. This is based on the definite conception that an increase of circulating cholesterol plays a part in gall-stone formation, and also on the fact that an increase in circulating cholesterol may be exogenously due to a diet rich in these substances. It therefore follows that cholesterol-rich substances are eliminated from the diet. Chauffard gives a list of cholesterol-low foods to be used in this condition. They exclude yolk of eggs, peas (phytosterol), fatty meats, and all fried foods.

I have used such a method, and while my surgical brethren do not agree with me, I can point to a number of individuals who undoubtedly harbor gall-stones (some demonstrated by the *x*-ray) who are free from symptoms. I am fully aware that when a stone migrates, no cholesterol-low diet in the world will relieve them. *Any method, however, which probably reduces further formation of stone is indicated in cholelithiasis.* I am also fully aware that by no means all stones are cholesterol stones. A fact which Rosenbloom recently pointed out is of value, namely, *that probably most cholesterol stones are non-infected, and that in the absence of demonstrable infection, as demonstrated by culture, this method of treatment is justifiable.*

Apart from the cholesterol content, the diet in these conditions should be low in protein and low in fats. *Low in protein because, as Meltzer pointed out, peptone is probably the best cholagogue, and low in fats because a high fat diet favors migration of stone extension or activity, and activity rather than rest to the diseased organs.* The formula, then, is high carbohydrate, low fat,

and low protein; such a diet is the classic diet of the French for disease in this region.

Local Treatment.—Direct treatment to the gall-bladder and bile-passages is impossible. Two means of treatment are possible: (1) To the ampule of Vater through the duodenum; (2) alteration of bile by altering the portal blood through the intestinal tract. I have used the *duodenal tube connected with*

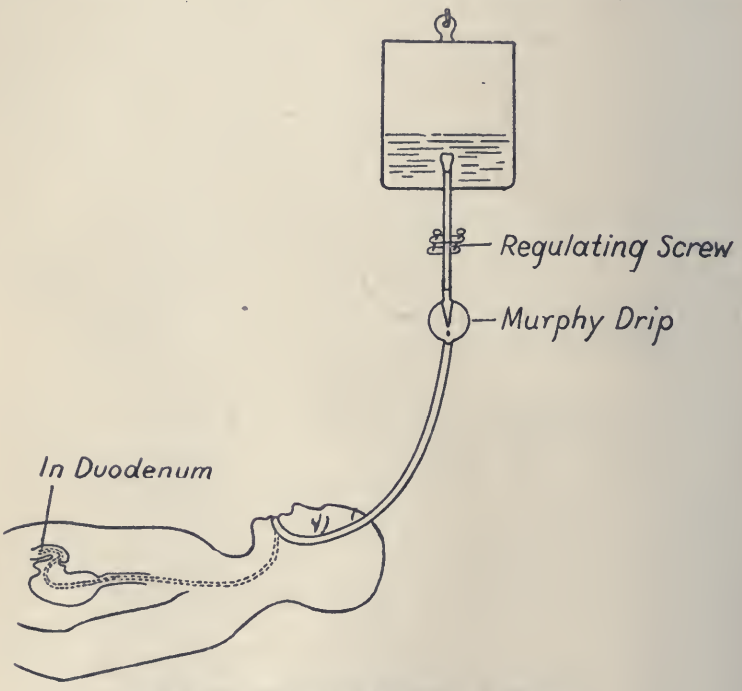

Fig. 147.—Drip system applied to duodenum.

the Murphy drip. This method of treatment consists in the passage of the duodenal tube or the gastroduodenal tube in the customary way. After bile is obtained, the end of the tube is linked up with the Murphy drip apparatus, and the disinfecting or cleansing solution run through at a rate of from 40 to 60 drops a minute. Solutions are used according to their purposes. Disinfecting solutions consist of the use of dilute solutions of the various silver solutions. I have used argyrol, protargol, and

even nitrate of silver, although the effect of the latter cannot be properly controlled. Methylene-blue has also been used in this way, as well as salicylic acid. As a rule, disinfecting solutions should be used in rather concentrated form, and usually I use only from 4 to 6 ounces of fluid in this way. Urotropin can likewise be used in the same way. I have used as much as 4

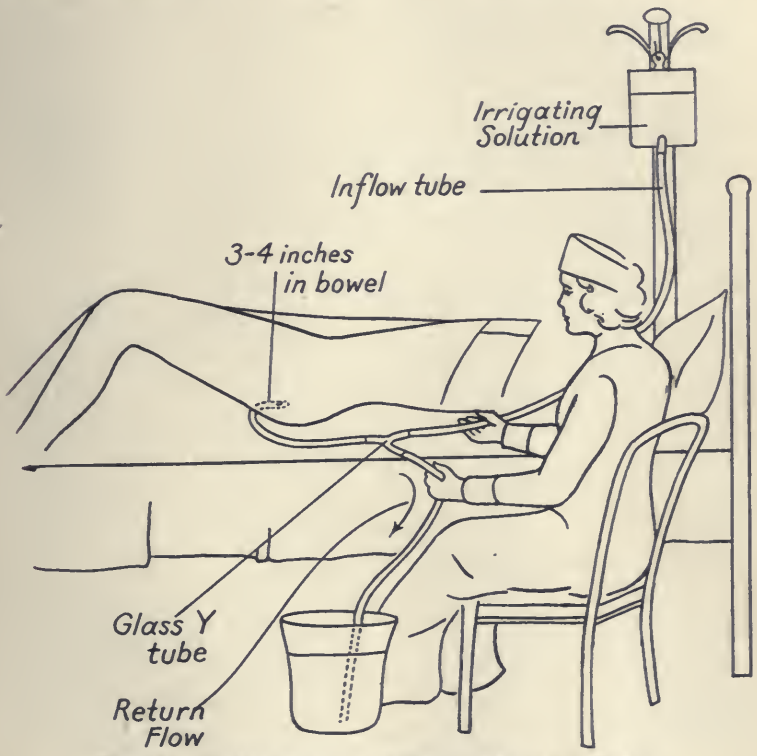

Fig. 148.—Nurse conducting double irrigation of the bowel.

grams at a single treatment. The second group of solutions are, in the main, cleansing and mucus-dissolving in their action. This includes concentrated solutions of sodium bicarbonate, sodium phosphate, sodium sulphate, or fairly strong dilutions of liquor antisepticus alkalinus. The laxative or cathartic effect can be obtained by adding these substances. I have treated many cases of infected jaundice and duodenitis in this way.

Some of them have been associated with cholecystitis and cholelithiasis. In the hands of an experienced nurse this treatment is often very successful.

The second point which impresses me as of great importance in these cases is the necessity of caring for the colon. Practically all of these cases have disturbances in bowel functions; in fact, the more I see of gall-bladder disturbances and also troubles with the gall-ducts, the more I am impressed with the primary importance of the bowel. The clinical symptoms apart from those which are purely localized are those associated with the "syndrome of mild reversed peristalsis." Acute disturbances are almost always associated with an increase in the irritability of the abdominal sympathetic plexuses and spastic tendencies in the bowel wall. Many are associated with evidences of colitis and enterocolitis; some infected others in which no actual influence of infection can be elicited. It must be evident that colon stasis and infection is followed by the transmission of these products by way of the portal system to the liver. The liver then must suffer, and its function be altered or perverted. Therefore it is logical to assume that modification of bile and of liver function should occur. *It follows that the logical treatment of hepatic and biliary disturbances should be by way of the bowel, which will directly or indirectly influence these organs by way of the portal system.* The influence of high irrigation of the colon and the marked improvement which occurs in certain cases must undoubtedly occur in this way. In almost every case it has been my practice to determine the condition of the colon, and to attempt to influence hepatic and biliary function in this way.

CLINIC OF DR. J. P. CROZER GRIFFITH

UNIVERSITY HOSPITAL

DILATATION OF THE COLON IN CHILDREN, WITH ESPECIAL REFERENCE TO THE IDIOPATHIC FORM

DILATATION of the intestine, and especially of the colon, is frequently observed in early life. It may be divided into (1) the secondary and (2) the primary or idiopathic form; the latter being of unusual occurrence, but of great interest on account of the necessity of distinguishing clearly the common secondary form from it. The causes of secondary dilatation are various. In rare instances an organic obstruction exists, such as a congenital stenosis in the course of the lower colon or the rectum, or the pressure of a tumor from without upon the intestinal wall. Chronic constipation may eventually produce great dilatation of the colon, although this is a result oftener seen in adult life than before this period. Any long-continued debilitating disease may give rise to dilatation. Most marked in this class of causes is rachitis, and the abdominal distention produced by this is of every-day observation. The dilatation may occur in any part of the gastro-intestinal canal, but appears to be oftenest in the colon. The very great degree of atony of the muscles of the abdominal walls, as well as of those of the intestine itself, readily permits of dilatation developing, and this is aided, too, by the intestinal indigestion which is often present. Sometimes the food employed has been of a nature which easily favors fermentation in the intestinal canal, and consequent increase of its lumen. Whatever the cause, it is safe to say that more or less dilatation is found in every case of rickets, and that in the severer ones it is one of the most prominent features (Fig. 149). The

abdominal distention in many of these cases is rendered still more striking by contrast with the narrow, contracted chest which such subjects exhibit, the deep Harrison's groove, and the flaring costal border.

Another cause of persistent and often very considerable dilatation of the colon is chronic intestinal indigestion, as it occurs

Fig. 149.—Severe case of rickets with much distended abdomen. From the Children's Hospital of Philadelphia.

especially in the second year of infancy and during early childhood, *i. e.*, from the second to the sixth year. The small intestine is dilated as well, but the chief distention occurs in the colon. The general symptoms of this disease are more or less characteristic. There is a loss or perversion of appetite, anemia, irrita-

bility or other signs of nervousness, loss of strength, emaciation, disturbed sleep, and, it may be, retardation of growth. The bowel movements are in some cases constipated; in others loose, or these conditions may alternate. They may contain large amounts of mucus, or may be much too light in color, owing to the failure of the proper digestion of the fat of the food. Even when not of this color, microchemical examination may show an excess of this element. Undue fermentation of the carbohydrate portion of the diet takes place and results in the accumulation of a large amount of gas, and often in the production of irritating diarrheal evacuations. Various other manifestations, especially those of a nervous nature, are observed; but the most important symptom from the present view-point is the distention of the abdomen, which is nearly always present in cases past the period of infancy. The same causes are operative here as in rachitis; namely, the atony of the abdominal and intestinal musculature, and the abnormal intestinal fermentation. In many instances the abdominal distention is by far the most striking feature.

Another cause of abdominal distention in early life is pneumonia. Here the condition is of an acute nature, and probably the whole gastro-intestinal canal shares in the distention. Little further reference need be made to it here, except to point out its bad prognostic indication. It probably results from the paralyzing action of the toxemia of the disease, and not only indicates the severity of the attack, but itself adds to the distress and danger by the upward pressure of the gas against the diaphragm, and the consequent interference with the action of the heart and lungs.

Acute peritonitis may produce a temporary dilatation of the small intestine and colon through the paralysis of peristalsis; and tuberculous peritonitis may give rise to a gaseous distention of a much more chronic nature.

The form of dilatation of the colon, however, to which especial reference is made in this connection is often denominated congenital idiopathic, and is sometimes called Hirschsprung's disease. The following is the history of an instance of this interesting disorder:

William W., aged three years and four months. The child was brought to the Children's Ward of the Hospital of the University of Pennsylvania September 3, 1918, on account of vomiting and chronic constipation. The mother said he had been subject to attacks of vomiting since birth, especially at times when purgatives, such as castor oil and Epson salts, had

Fig. 150.—Idiopathic dilatation of the colon in a child of three years and four months in the Children's Medical Ward of the Hospital of the University of Pennsylvania. The peristaltic movements can be seen below the left costal border.

been administered to relieve the constipation. At such times he lost his appetite, but, as a rule, this was good. The attacks of vomiting were said to have lasted a few days at a time or even a week. The vomiting caused but little discomfort. There had always been constipation, and a week passed at times without an evacuation. The feces were said to be dark-colored and lumpy, and on occasions to have contained large curds. The time when

the distention of the abdomen was first noticed was not stated. The child had been in good general health, of fair weight, playing out-of-doors, and eating and digesting well, except during the attacks of vomiting.

Examination on Entrance.—The patient is rather apathetic. The general health seems good. The head is slightly rachitic in shape. The tonsils are enlarged and the mouth is held open a portion of the time. The chest is only fairly well developed, but is without rachitic rosary. The most marked feature is the very large abdomen, which is tympanitic on percussion, and exhibits, especially when manipulated, very active peristaltic movements of large excursion, the outline of the much distended colon showing distinctly through the abdominal wall (Fig. 150). The peristaltic movements of the small intestine are also visible. The arms and legs are thin, but otherwise normal, except for a moderate degree of genu valgum.

Later History While in the Hospital.—The child grew very bright and playful, with abundant vitality, as he became acquainted with his surroundings. A test-meal given showed nothing abnormal in the digestive or propelling power of the stomach. Constipation remained a marked feature unless relieved artifically. The muscular wall of the abdomen was decidedly thin and weak, tense, and with a slight umbilical hernia. The forcible waves of peristalsis persisted, and were attended by a very audible gurgling sound. A fluoroscopic examination was made and *x*-ray plates taken after 3 pints of a suspension of barium had been given by rectal injection. There was hesitation about administering a larger amount, as this quantity was as great as would have been used in the case of an adult. The enormously distended colon could be readily seen (Fig. 151), but the amount of fluid used did not extend as high as the transverse colon. The rectum was not distended. Measurement of the abdomen at the umbilicus gave a girth of 23 inches (57.5 cm.). Vomiting occurred for the first time on September 18th, fifteen days after admission, and then only once. Massage of the abdomen was given daily and the diet regulated to contain as little waste material as possible. Liquid petrolatum was

administered by the mouth and soap enemata employed. About September 30th the patient was attacked by the epidemic of

Fig. 151.—Radiograph of Fig. 150, viewed from behind. Showing the great distention of the ascending colon. Not sufficient fluid injected to pass into the other parts of the colon.

grip then prevailing in the hospital and elsewhere. During this there was a return of vomiting, and diarrhea developed, and the child became apathetic and quite debilitated. The diarrhea

persisted for some time, but without any special diminution in the girth of the abdomen. Later the severe symptoms disappeared, the patient reached his former bright and happy condition, and he was sent to the country to convalesce, where he is at this writing.

Idiopathic dilatation of the colon is an affection even yet not common, although more often recognized than was formerly the case. In an article published in 1889, which included the description of an instance of the disease, I could collect but 23 previously published reports which seemed without question to belong to this category. Since then the number of recorded cases has been increased greatly. Finney, in 1908, gave a list of 206 publications upon the condition; Patel, in 1910, collected 223 cases, 200 of which had been confirmed by operation or by post-mortem examinations; and Porter and Weeks, in 1915, added 100 more to the list. While it is true that Hirschsprung in 1888 made the first careful, analytic study of the disease; yet instances had repeatedly been reported earlier, as by Parry, Billard, Henoch, Peacock, and Hughes. There seems no good reason, therefore, why the disease should bear the name of Hirschsprung rather than of another.

The nature and cause of the malady are still far from being thoroughly understood. There probably exists a congenital tendency for the colon to dilate, although the actual dilatation is not always present at birth. On what the tendency depends and in what manner the dilatation is brought about are by no means clear. The disturbance has been supposed to be neuromuscular in nature, being a paralysis of some region of the colon with arrest of peristalsis; or perhaps a spasm producing functional obstruction; and still other views have been entertained. These theories have not been satisfactorily confirmed by post-mortem examinations. The dilatation is clearly not the result of a general muscular atony, for, although this is operative in that developing in severe rickets, the subjects of idiopathic dilatation are children in other respects entirely healthy. Much has been written of the influence of the remarkable length of the colon, and especially of the sigmoid flexure, characteristic of early

life, as compared with the rest of the intestine; but the very fact that this condition is so very common is immediate proof that it cannot be more than a predisposing cause of dilatation, as otherwise the disease would be of every-day occurrence. It has been maintained, too, notably by Treves, that the dilatation may depend upon some constriction in the lower part of the colon or in the rectum. Such cases exist, and I have seen one interesting example in which the diagnosis was made by operation, and recovery followed. But it is clear that any such cannot be called "idiopathic"; and autopsies have failed to reveal any condition of this kind in the majority of instances. It has further been a matter of dispute whether the hypertrophy of the intestinal wall, which is found as a nearly constant occurrence, is a cause or a result of the dilatation. Certainly in some fatal cases in early infancy both conditions have been present, and in these the hypertrophy could not have been a secondary process depending upon constipation. We are not justified, therefore, in assuming that the constipation is the necessary principal factor which is finally followed by dilatation of the lumen of the bowel and hypertrophy of the walls.

The lesions found at autopsy are characteristic. The colon may be involved throughout, or only the sigmoid flexure. In some instances the rectum and the lower part of the ileum are also affected. In an analysis of 169 cases published by Neugebauer the sigmoid alone was dilated in 74, and the entire colon in 32; in 26 the rectum also was involved. The distention is frequently so enormous that on opening the abdominal cavity little other than the dilated large intestine is visible. In addition to the dilatation there is nearly always found thickening of the intestinal wall. This produces a lack of elasticity in it and increases the trouble. In long-standing cases inflammatory changes and even ulceration develop.

The symptoms need be but briefly discussed, since they are so characteristic. They are principally two—constipation and great distention of the abdomen due to the dilatation of the colon. Usually constipation is the first of these to appear, followed more or less promptly by the other. The symptoms may be present

at birth, but in the large majority of cases (153 of 210 cases collected by Neugebauer) only the *tendency* exists at this time. The symptoms themselves generally appear in the first three months. Occasionally actual dilatation does not develop until the age of a year. The constipation is of a most obstinate nature, the child passing one or two weeks, it may be, without a stool, unless relieved by treatment. A stool without assistance is uncommon. After such an interval the evacuation is, of course, enormous. It is noteworthy that the fecal matter, although often dry and in large masses, is not, as a rule, scybalous, the constipation depending not upon any characteristic of this nature, but upon the lack of expulsive power of the intestine. In fact, in some instances, at least for a time, as in the case now reported, the stools are diarrheal in nature, and there may be for periods a liquid evacuation daily, yet without necessarily any great difference in the degree of abdominal distention. The amount of distention, in fact, varies with the case, and to some extent from time to time in the same patient. After a thorough evacuation by enemata there may be quite a considerable reduction in the girth; but this is not true in every instance. In the case now reported the circumference of the abdomen equalled 23 inches (57.5 cm.); and I have seen other instances in children younger than this patient with a greater girth. In cases not too far advanced very active peristaltic movements of the colon are visible. This was very markedly true of the instance here recorded. It is remarkable how comfortable and in what good general health the patient may be for a number of years. There is seldom much pain, and vomiting cannot be regarded as a characteristic symptom. Dyspnea may be produced by the pressure upward against the diaphragm, but, as a rule, not to any great degree.

The ultimate prognosis is not favorable. Of 24 cases of my own previous report, 18 were known to have died. In 59 cases treated medically, as recorded by Löwenstein, the mortality was 66 per cent. In 110 operated cases collected by Terry the mortality was 44 per cent. It is not usual for the subjects to reach adult life, and most of them die before the age of five years from

increasing debility or from some intercurrent disease. Treatment is, therefore, a matter to be considered with care. To operate would at first sight appear to be the safest course, doing by preference a resection of the dilated portion of the intestine; but in view of the high mortality which has attended the procedure it seems oftener wiser to temporize, if the general health is not being impaired. In 2 instances seen within the last two years I have advised delay. One was a vigorous colored child of four years, whose case has been reported elsewhere; the other the subject whose history we have been considering. In each instance the general health was good and the patient in no way suffering through the delay. In such instances relief may be obtained from time to time by colonic irrigation or by purgatives. These procedures should not be resorted to oftener than necessary, as there is danger of increasing the weakness of the expulsive power. Strychnin may be administered in the hope that it may increase the intestinal tone, and abdominal massage is certainly useful in aiding the expelling of the intestinal contents.

After all, however, the practical importance of idiopathic dilatation is inconsiderable by itself, inasmuch as the disease is so seldom encountered. What *is* of the utmost importance is the diagnosis between this and other forms of dilatation, since should this not be clearly established and should operation be advised in cases which are of a purely secondary and remediable nature, the patient is placed in entirely unwarranted danger of losing his life through the mistake of the physician. For this reason the discussion of diagnosis has been deferred until now. I recall with vividness an instance in which I was called in consultation to confirm the attending physician's opinion that the disease was idiopathic dilatation of the colon, and to sustain him in the advice he had given that the colon be resected. The patient in the condition in which I then found him might with good reason have been considered a case for operation so far as the symptoms present at this time were concerned; but it so happened that the little boy, then four years old, had been under my own care during the first two years of his life, and that I knew he had been the subject of severe chronic intestinal indigestion with abdominal

distention. This enabled me to make a diagnosis which might otherwise have been difficult. The little fellow was subjected to no operative interference and is now an entirely healthy child.

The diagnosis of the nature and cause of dilatation of the colon is, as intimated, by no means always easy. The acute abdominal distention attending pneumonia is readily recognized, and should be so promptly, on account of its bad prognostic import. It calls for all possible measures to sustain and increase the vital forces. In occasional instances where other means for obtaining an expulsion of the gas have failed, I have seen the hypodermic injection of eserin act most satisfactorily, giving $\frac{1}{500}$ to $\frac{1}{300}$ grain at the age of two years, and repeating this if necessary. The drug is, however, a possible depressant and may do damage, although this may be counteracted to a certain extent by combining it with strychnin. The gaseous abdominal distention seen in acute peritonitis is, as a rule, readily recognized by the accompanying symptoms; that attending some forms of tuberculous peritonitis is not so easily distinguished. Time, however, will solve the matter. The onset in tubersulous peritonitis is not so slow, and the condition occurs later in life. There is abdominal tenderness, and fluid or tumor masses may be discovered, the latter being distinguished from fecal accumulations by their permanent and fixed position, not affected by colonic irrigation. Fever is present, and there are generally other evidences of tuberculosis. The general health is usually early affected. It should be stated, however, that in some cases of idiopathic dilatation fecal masses felt through the abdominal wall may not be removed by enemata.

Rachitic dilatation may be very decided and very prolonged, yet can rarely cause any difficulty in diagnosis. It develops in infancy, it is true, but only after earlier symptoms of rachitis have shown themselves; and it is not as great as in idiopathic dilatation. It is attended by contracted thorax and general poor health without obstinate constipation. The prognosis is, of course, good, so far as the distention is concerned, the general rachitic condition being that which needs immediate and prolonged treatment.

The numerous cases of chronic intestinal indigestion accompanied by distention of the abdomen are those which are most likely to cause errors in diagnosis. This disease begins usually at a later period than idiopathic dilatation of the colon; bad health precedes the dilatation, there having been long-continued intestinal symptoms, especially diarrhea; constipation is never as pronounced; the distention is usually not so great. It is, in fact, difficult to confound the two if a satisfactory previous history of the patient can be obtained. Operation is, of course, never indicated in this disease. Recovery, though slow, is to be hoped for in most instances through care for the regulation of the hygiene and diet. The nature of this is a matter too extended to be discussed further in this connection.

CLINIC OF DR. MAURICE OSTHEIMER

UNIVERSITY HOSPITAL

FEEDING BABIES DURING THEIR SECOND YEAR

THIS baby is shown to you simply as a text. You will all note that she is not sick—on the contrary, she shows all the marks of an exceptionally well child. You can definitely place her among the "overfed" at once, from her looks alone. Let me give you the few important facts in her history. She was breast fed for only three months; then her mother weaned her for no real reason whatever. She was given condensed milk, then malted milk, then the various other proprietary foods. We first saw her when she was six months of age, a pale, flabby, undernourished infant, weighing 10½ pounds. It took little time and very little trouble to start her on a cows' milk mixture, 6 ounces every three hours, slowly. She improved at once, and her mixture was gradually increased until she finally reached whole milk at eleven months. At one year she had five teeth, could chew zwieback well, took oatmeal, orange-juice, and prune-juice once a day besides her milk. She weighed 20 pounds at twelve months of age.

She is now twenty-five months old and weighs 33 pounds. Her appetite is excellent, but she gets only three meals a day, with absolutely nothing to eat between her meals. She is allowed frequent drinks of water, but no crackers, cake, pretzels etc. But her meals are large, very large compared to those advocated by most of the text-books, as any of you will find, if you take the trouble to look up this subject. It has been the common practice to keep infants on a liquid diet until they reach eighteen months or later, beginning semisolid and solid food very gradually, even at that age.

Even at twelve months of age she was allowed only three meals, and these were fairly large, too: breakfast consisted of 1

tablespoon of strained oatmeal with milk, but without sugar, one slice of toast or zwieback, the juice of one orange, and one cup of milk. At dinner she had one-half, later one, baked potato or soft-boiled egg, two slices of toast, two tablespoons stewed prunes, and one cup of milk. At supper she had two slices of toast with butter, 2 tablespoons of prunes or apple sauce, and one cup of milk. From time to time the stewed fruit was changed in variety or orange-juice was given frequently in place of the stewed fruit, and whenever she seemed unwilling to eat much, she was given more milk in place of the solid food. As she grew in size and weight she was offered more variety and greater quantities of food, until she now takes for breakfast 3 or 4 tablespoonsfuls of some well-cooked cereal, unstrained, 4 tablespoonfuls of stewed fruit or the juice of one orange, two slices of zwieback with butter, a soft-boiled egg, and one-half to one cup of milk. Her dinner now consists of about ½ ounce of beef, chicken, lamb, or boiled fish on alternate days, with a baked potato or 2 tablespoonfuls of boiled rice, 2 tablespoonfuls of spinach, two slices of toast and butter, and 2 tablespoonfuls of stewed fruit, with one-half to one cup of milk; on the alternating days on which she does not have meat she takes 4 tablespoonfuls of some cornstarch or custard instead. Her supper consists of three slices of toast and butter, 4 tablespoonfuls of stewed fruit, and one cup of milk, besides one of the following: a soft-boiled egg, a baked potato or cornstarch or custard, when she has not had one of these foods already in the day.

You can see how well she is; her mother will answer any questions about her. She has one or two bowel movements daily, usually two; from time to time the "soap-stick" is used to start her bowel movement. She is active, but still takes a short nap in the early afternoon. She goes to bed at 7 o'clock and sleeps until about 7 the next morning. There is no question about her intelligence; you can see that she is not nervous.

It was to speak of the rather radical changes in our method of feeding infants after weaning that I showed you this child. Last year I brought this matter before the Philadephia Pediatric Society (at the meeting held January 9, 1917), but that discussion

was never published. We noticed, here, that many babies needed weaning between nine and twelve months, after having been fed upon undiluted milk without gaining. We noted, too, that many of these infants had several teeth, and investigation showed that they readily learned to take and apparently to assimilate semisolid and solid food. We found that milk was commonly either continued as the infant's sole food or was given in excessive quantities late into or even throughout the baby's second year. At this time beef-juice, beef, mutton, and chicken broths are also given in what appears to us to be greatly excessive quantities. Upon searching through the literature we found that most of the text-books on diseases of children advise from five to six meals a day, consisting chiefly of milk and broths. Crackers were advised in many instances also. Our experience here, covering, as it does now, eighteen years, has shown us that most, if not all, crackers produce much indigestion, whether eaten between meals, taken at meals, or given soaked in water or milk.

While it is important that the transition from a diet consisting solely of milk to one containing a variety of food-stuffs be made gradually, we firmly believe that the attempt to teach infants to take solid food should be made just as soon as the baby fails to gain upon milk alone and has at least four opposing teeth. The development of the baby, that is, his anatomic age, is a far better guide to feeding than is his actual age.

As a rule, every baby starts upon three meals a day at some time between ten and fourteen months; until he has learned to take at each meal enough of the variety of foods offered he is allowed a drink of milk, from a cup or spoon (thus abolishing bottles early), halfway between meals, but this is discontinued just as soon as the baby learns to eat three good meals.

The bad habit of an early bottle or the practice of giving orange-juice early in the morning is stopped; and breakfast is prepared as early as suits the mother. At first breakfast consists of a well-cooked cereal, preferably oatmeal, strained, with salt and milk added, but without sugar or cream (but farina, barley, rice, or other cooked cereal may be used for variety); a little zwieback, toast, or stale bread, and milk last, from a cup

or spoon. Much of the toast will drop out of the baby's mouth at first; but a few days' experience results in attempts at chewing and swallowing. Stewed fruit, apple sauce or baked apple, or orange juice are allowed, and more toast, zwieback, or stale bread; soon with butter added. The amounts are then increased to a saucer of cereal, three or four slices of toast with butter; a saucer of apple sauce or stewed fruit; and a soft-boiled egg is soon added.

We have noticed, as Kerley has,[1] that in some infants milk and orange-juice given at the same meal disagree; and that eggs do not agree with some babies early, as Grulee[2] pointed out. But we also found that most babies could take both milk and orange-juice together, and eggs soon after twelve months of age, without any symptoms developing.

Dinner consists at first of baked potato or a soft-boiled egg, with toast, zwieback or stale bread and butter, stewed fruit and milk. When the baby takes his egg for breakfast, it is omitted at dinner; but by this time a well-cooked green vegetable, well mashed or strained (spinach, peas, string beans, lima beans, asparagus, at first; later, cauliflower, Brussels sprouts, or boiled cabbage), has been added daily. Next chicken, beef or lamb, or boiled fish, finely chopped up, is given twice a week. Cornstarch, custard, or milk pudding are given on the days on which the baby gets no meat. No scraped raw beef is ever permitted; broths are allowed very seldom, not more than once a week, and then not more than 3 or 4 ounces; and beef-juice is only given in small quantities to the greatly undernourished children, as a stimulant rather than a food.

Supper consists first of toast, zwieback or stale bread, with butter, stewed fruit, and milk. Later a soft-boiled egg may be given (the second or even the third egg in a day, when eggs agree and the baby likes them); or a baked potato, cornstarch, custard, or milk pudding for variety. It is not fair to the baby to offer him exactly the same meals day after day. Variety will help much. The different cereals, always thoroughly cooked, may

[1] C. G. Kerley, Practice of Pediatrics, 1914, p. 97.
[2] C. G. Grulee, Infant Feeding, 1912, p. 143.

be given for breakfast, although oatmeal is undoubtedly best. When meat is given for dinner, no dessert is needed; but when the baby gets no meat, the cornstarch, custard, or milk pudding is allowed. Boiled rice may replace the potato at any meal, when the infant grows tired of potatoes. Enough should be given at each meal, but especially at supper; for the infant who eats a good supper will rest far better than one who only plays with his food and eats but little before going to bed.

Nothing to eat is allowed between meals, but drinks of water are encouraged. Especial condemnation must be expressed against the common practice of giving crackers between meals. Investigation among those babies who so often awake screaming an hour or two after going to sleep showed that they had very frequently, if not invariably, been fed crackers some time during the afternoon. Simply eliminating the crackers at once cured this condition in a large number of cases. Infants should take neither tea nor coffee; should have no alcohol, candy, fresh cake or bread; pickles, spices or condiments, including salad dressing; pork, veal, salt meat or salt fish; nothing fried; no nuts, no uncooked vegetables or fruit excepting the fruit juices; and no hard-boiled eggs.

It is important not only that the baby's food be properly prepared but also that it be given to the infant slowly, by some person endowed with patience and the ability to distract the baby's attention, amusing him by talking or story-telling, so that he unconsciously continues to open his mouth each time the spoon approaches his lips. In this way the baby will take sufficient nourishment at each feeding, reducing the action of his digestive functions to three times a day, with a normal period of rest between, instead of the old fashion of five or six meals daily, without sufficient rest between meals.

It is important, also, that the baby be fed regularly, having breakfast between 7 and 8 A. M.; dinner between 12 and 1 P. M., and supper between 5 and 6 P. M., so that he is in bed before 7 o'clock at night. It is also important to teach these infants to chew their food well before they reach the age of two years; and their teeth will need care by this time.

We have had excellent results in over 300 of our dispensary patients fed in this manner, besides many others in private practice. We believe that there is much less indigestion among infants fed in this way; possibly because these babies have gradually become accustomed to digest a variety of food-stuffs, and an occasional indiscretion does not produce the upset which so frequently results in the infant fed upon milk alone. An increase in growth, both in length and in weight, is noticed at once, and these babies, being better satisfied, rest better and appear to be much more contented than the many infants who are still fed upon milk and broths alone, even though they are over fifteen months of age.

The smallest of the 308 babies of whom I have full notes, covering the period from twelve to twenty-four months, weighed 10 pounds at twelve months and 17½ pounds at twenty-four months. The largest baby weighed 24 pounds at one year and 39 pounds at two years. Eleven of these infants out of 308, 3½ per cent., died from various causes during their second year of life. Some of the other babies showed the following gains (lowest, 6½ pounds; greatest, 15 pounds):

12 to 19 pounds;	13½ to 20 pounds;	14½ to 21½ pounds;
15 to 23 "	15½ to 24 "	16½ to 23 "
17½ to 25 "	18½ to 29 "	19 to 27 "
20 to 33 "	(the child shown);	20 to 27½ "
21 to 34 "	22 to 30 pounds;	23 to 31 "
24 to 35 "	24 to 39 "	27 to 35 "

We believe that a baby of twelve months, weighing about 20 pounds, deserves more than most text-books allow. Instead of from 800 to 900 calories a day, this infant needs from 1100 to 1200 calories. In other words, the infant of one year should receive from 30 to 35 grams of protein, from 35 to 40 grams of fat, and from 160 to 180 grams of carbohydrate daily.

At the age of two years, weighing 30 to 35 pounds, the baby should have from 1700 to 1800 calories a day, and not 1200 to 1500 calories. That is, he deserves from 35 to 45 grams of protein, from 70 to 75 grams of fat, and from 180 to 200 grams of carbohydrate daily.

The exact amount taken by each baby will vary at each meal

naturally. If there is something he likes, he will take all you give him of that, and less of other things. Then his appetite will vary, too, so that he may slight one or more meals a day. But he will usually make up on the next meal. Everyone who has frequently watched children eat has observed that they may refuse to eat one thing, such as spinach or soft-boiled egg, for instance, day after day, week after week. Oddly enough, some day the baby will apparently prefer the taste of this hitherto despised food-stuff and will eat all of his egg or spinach and decline all or many of the various other things making up the meal, things which he had been eating and enjoying up to that time.

Finally, in two tables I have worked out approximately the calories to be found in the ordinary meals offered to these infants when they are twelve months old and when they reach the age of twenty-four months:

FIRST DIET LIST—BABIES OVER TWELVE MONTHS

Breakfast:	Grams.	Proteins, grams.	Fats, grams.	Carbohydrates, grams.	Calories.
1 tablespoon strained oatmeal	50	1.40	.25	6.75	32
1 cup whole milk	220	7.26	8.80	11.00	157
1 slice zwieback	15	1.47	.49	11.03	65
		10.13	9.54	28.78	254
Dinner:					
2 slices toast or stale bread	40	4.60	.64	24.48	124
½ butter ball	8	.08	6.38	..	60
2 tablespoons stewed fruit	83	.17	.67	31.00	134
1 cup whole milk	220	7.26	8.80	11.00	157
1 baked potato	130	3.77	.20	32.07	149
Or ½ soft-boiled egg	25	3.30	3.00	..	42
Or 1 tablespoon boiled rice	50	1.42	.05	12.20	56
		15.88	16.69	98.55	624
		or 15.41	or 19.49	or 66.48	or 517
		or 13.53	or 16.54	or 78.68	or 531
Supper:					
1 slice zwieback	15	1.47	.49	11.03	65
2 tablespoons stewed fruit	83	.17	.67	31.00	134
1 cup whole milk	220	7.26	8.80	11.00	157
		8.90	9.96	53.03	356
Totals		34.91	36.23	180.36	1234
		or 34.44	or 39.03	or 148.29	or 1127
		or 32.56	or 36.08	or 160.49	or 1141

LAST DIET LIST—BABIES OF TWENTY-FOUR MONTHS

Breakfast:	Grams.	Proteins, grams.	Fats, grams.	Carbohydrates, grams.	Calories.
2 tablespoons oatmeal.....	100	2.80	.50	11.50	63
½ tablespoon cream.....	10	.37	2.57	.36	27
2 tablespoons stewed fruit...	83	.17	.67	31.00	134
2 slices zwieback.....	30	2.94	.98	22.06	130
1 butter ball.....	15	.15	12.76	..	120
1 soft-boiled egg.....	50	6.60	6.00	..	84
½ cup milk.....	110	3.63	4.40	5.50	79
		16.66	27.88	70.42	637
Dinner:					
1 tablespoon spinach.....	50	1.05	2.05	1.30	29
2 tablespoons stewed fruit...	83	.17	.67	31.00	134
2 slices toast or stale bread..	40	4.60	.64	24.48	124
1 butter ball.....	15	.15	12.76	..	120
½ cup milk.....	110	3.63	4.40	5.50	79
½ baked potato.....	65	1.89	.10	16.04	75
Or 1 tablespoon boiled rice..	50	1.42	.05	12.20	56
1 tablespoon custard.....	15	1.10	1.71	3.03	33
Or ½ slice lamb (beef or chicken).....	38	7.39	4.76	..	75
		12.12 to 18.88	22.28 to 25.38	74.48 to 81.35	575 to 636
Supper:					
2 slices zwieback.....	30	2.94	.98	22.06	130
1 butter ball.....	15	.15	12.76	..	120
1 baked apple.....	120	.61	.58	29.30	128
½ cup milk.....	110	3.63	4.40	5.50	79
1 tablespoon custard.....	15	1.10	1.71	3.03	33
Or 1 tablespoon boiled rice..	50	1.42	.05	12.20	56
Or ½ baked potato.....	65	1.89	.10	16.04	75
Or 1 soft-boiled egg.....	50	6.60	6.00	..	84
		8.43 to 13.93	20.45 to 24.72	56.86 to 59.89	490 to 541
Totals.....		27.21 to 49.47	70.59 to 77.98	201.76 to 211.66	1702 to 1814

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CEREBRAL PALSIES OF CHILDREN

WHAT are usually known as the cerebral palsies of children are those due to abnormal birth and those which occur as sequelæ of the infectious diseases. There may be other causes, as hydrocephalus, brain tumor, multiple sclerosis, and the abiotrophies, by this term meaning the premature death or degeneration of nerve-fibers due to inherent constitutional weakness. In this lecture we shall consider in detail only those commonly included under this title.

The largest group of such cases is that due to abnormal birth, often termed Little's disease, after the English physician who first called attention to it. This group comprises cases due to injury during birth from the use of the forceps or from prolonged or precipitate labor, to premature birth, and possibly cerebral disease in the fetus during intra-uterine life. Jaundice in the newborn is also a cause.

The lesion is most commonly located in the motor region, on one side or on both. The symptoms most frequently seen are, therefore, motor in character. The paralysis may be monoplegic, hemiplegic, paraplegic, or diplegic in type, according to the extent of the damage. Other symptoms of destruction of the upper motor neuron are present, as increased tendon-jerks, spasticity, and contractures. Symptoms also frequently observed are various forms of spasmodic phenomena, as the slow, vermicular movements, especially of the hands and sometimes of the feet, and facial muscles, known as athetoid movements or athetosis. In other cases choreiform or ataxic movements may be observed.

Paralyses of cranial nerves and speech disturbances occur more rarely. In some instances very little loss of power is present and the disability is due to the rigidity or spasticity of the mus-

cles. The very serious features of these cases is that many of them develop epilepsy and that many are mentally retarded. Thus, Spratling attributes 11 per cent. of 1070 cases of epilepsy to this cause. In an analysis of 5430 cases of mental defectives varying in severity made by different observers, approximately 12 per cent. was probably due to injury at birth. These figures represent cases so caused, and not those resulting from infectious disease acquired after birth, which cases will be considered later.

It must be borne in mind, however, that all do not develop these conditions and that some may be quite intelligent. Many of these cases are not recognized until some time after birth, frequently nothing is noticed until the child is old enough to sit up. When the condition is due to injury at birth, symptoms are present, as a rule, very shortly after, but to appreciate their nature the character of the lesions must be understood. This is hemorrhage either subdural or intermeningeal, due to tearing of the cerebral veins. Thrombosis of the superior longitudinal sinus may also occur. The hemorrhage with resulting clot may be unilateral, when hemiplegia usually results; or, it may be bilateral, when the effect is limited to the upper part of the brain and paraplegia follows, and if extensive, diplegia occurs. Hemorrhage is probably favored by the overlapping of the parietal bones during the molding of the fetal head. Owing to obstruction of the cortical venous system more or less softening of the cortex is liable also to occur. Rarely the hemorrhage may be arterial. More rarely the veins leading to the lateral sinuses may be torn as the occipital bone is pressed under the parietal, in which case the hemorrhage is subtentorial. Paralysis of some of the cranial nerves may be so caused. Many of these cases are either stillborn or die immediately after birth. Those who survive develop some of the following symptoms: if supratentorial, therefore involving the cortex, there is usually asphyxia after birth followed by restlessness, refusal to nurse, and convulsions, which may be unilateral. Examination will show some of the following conditions: Edematous or bulging anterior fontanel, muscular rigidity, subconjunctival hemorrhage, edema of the eyelids, inequality of the pupils, slow action of the heart,

and more or less papilledema. If the hemorrhage is infratentorial the early asphyxia is not so marked; in a few hours breathing becomes irregular and rapid owing to involvement of the nerves at the base of the brain, distention of the fontanel is not marked until late. There will be also marked rigidity of the muscles, especially those of the neck, sometimes with retraction of the head. The presence of these symptoms indicates that a lumbar puncture should be done, when the fluid will usually be bloody and under increased pressure.

The amount of blood is apt to be greater in infratentorial than in supratentorial hemorrhage. These symptoms frequently do not attract attention, and, as has been said, nothing is noticed until the child is old enough to sit up. Then the parents will observe that it is unable to do so. Even when the child is sat up the head will fall forward or roll about, owing to weakness of the muscles of the neck. It may be noted that the child does not move its limbs about as it should or that it moves those of one side and not the other. In some cases convulsions may occur at intervals, or various spasmodic or choreiform movements of the limbs are noticed. These may be mistaken for chorea. If examined, more or less rigidity of the limbs will be found, according to the type of the paralysis previously mentioned.

J. D., æt. twelve weeks, is an example of a probable birth injury with resulting hemiplegia. This child had to be delivered by version. On the third day it had a series of convulsions lasting for twenty-four hours. At the present time the child is paralyzed on the right side, and it will be noticed that the defective limbs are rigid and that the knee-jerk is possibly somewhat increased. The Babinski reflex is also present, but in a patient of this age this has no pathologic significance, as the phenomenon is normal in infants up to three or four years of age.

H. B., forty-two years of age, has a history which is very characteristic of the condition of which we are speaking. He is the second child of fifteen. Of this number, one was stillborn; one was prematurely born at eight months and lived five days; another had convulsions during the first week and died. The others are living and, with the exception of the

patient, are healthy. The birth of this patient was normal; no instruments were used; labor was said to be easy. The mother, however, during the ninth month of her pregnancy fell down a flight of steps, but noticed no ill effects. On the third day after birth the child had convulsions. From this time nothing was noticed until the time when he should have been sitting up, when it was found that he was unable to do so. He did not walk until he was nine years of age. The present condition is one of marked rigidity of all four limbs. The patient is able to walk, but with great difficulty, and with dragging of the feet along the ground. The knee-jerk, biceps- and triceps-jerks are increased and an ankle-clonus is present. There is marked speech disturbance, so that it is difficult to understand the patient. What especially attracts attention, however, are the continuous, slow movements of extension and flexion of the fingers and hands, also at times of the arms, and the irregular contractions of the facial muscles when he attempts to speak. These movements are those known as athetoid movements. The patient's mental condition is deficient, although he understands fairly well what is said to him.

These patients represent types of the usual conditions following birth injury. However, other symptoms may occur, but not commonly. Thus, cases have been described in which instead of spasticity there is extreme flaccidity of the limbs. In addition, the child for several years is unable to walk or stand, and if it does become able to do so, ataxia will be noted. Disturbance of articulation and mental deficiency are also usually present. There is no muscular atrophy. The knee-jerks may be either absent, normal, or increased, and the Babinski reflex may or may not be present. This type has been termed either the "atonic astasic type of infantile cerebral paralysis" or "cerebral diplegia of flaccid atonic type." In the few cases that have come to autopsy lesions in the frontal lobes were observed.

A case somewhat resembling this type is W. B., æt. three years. This patient is a first child and an instrumental delivery was necessary. Three days following birth he had a series of convulsions lasting for several days. He began to walk at the

age of sixteen months. His gait, however, was somewhat unsteady. Examination will show an unsteady gait; the hands are used clumsily when he attempts to touch or pick up objects. There is also some slight tremor of the hands. The knee-jerks are present, but not increased, and no undue rigidity or spasticity will be noticed when the limbs are moved. The patient since birth has had from time to time convulsions of an epileptiform nature. His mental powers are not what they should be at his age. Speech is somewhat indistinct.

In some instances ataxia of a cerebellar type develops. In these cases there will be the usual history of difficult labor, backwardness of mental and physical development, and when the child learns to walk the gait will be noticed to be very unsteady, resembling that of a drunken man. Ataxia of the hands may also be present. Defective speech, which is slow and jerky, nystagmus, and tremor of the head may sometimes be observed. In these cases muscular power is good and there is frequently a considerable degree of improvement. Such cases have been termed the cerebellar type; the lesions are supposed to involve the cerebellum.

Hunt, of New York, has recently reported several cases which he has termed the "ataxic type of cerebral birth palsies," and, on theoretic grounds, believes that the symptoms are due to the hemorrhage and resulting lesions being limited to the parietal lobes. The ataxia is bilateral, involving the arms and legs, and is present when the patient is lying down. Speech is defective. The cases which Hunt has described resembled symptomatically very much those designated as the cerebellar type. There has been no actual demonstration of the lesions in either of these classes of cases.

As has been stated, there are certain cases in which the symptoms described are not due to injury, but occur in children born prematurely. They are due to a failure of the motor centers and of the pyramidal tracts to develop. In some the only abnormality is a fineness and diminution in number of the fibers of the pyramidal tracts. The symptoms, except that those described as occurring just after birth do not occur, are

similar to those following injury with hemorrhage. Mental deficiency and epilepsy do not develop quite so frequently as in those due to hemorrhage.

M. S., two and one-half years of age, is an example of this class. She was a six months' child and weighed one and one-half pounds at birth. At the present time she is unable to stand or walk, but can sit without assistance. Both arms and legs are excessively spastic. Contractures will be noticed; the knee-jerks are markedly plus.

Another example of this type is F. H., twenty-eight years of age. He was a seven months' child and did not walk until he was four years of age. There is extreme spasticity of the muscles of both arms and legs; the tendon reflexes are all increased. The Babinski reflex is also present. It will be noticed that on testing the muscular strength of this patient it is very good, and he is an example of that type in which the disability is due more to excessive rigidity of the muscles than to loss of strength. He has, as will be seen, very marked athetoid movements of the arms and contortions of the facial muscles. In this case the movements of the limbs are so violent that the hands will fly up, at times striking him in the face.

Some of these cases may be due to hereditary syphilis, and in the patient, H. B., in whose family history we find that three other children probably had the same condition as the patient, the possibility of hereditary syphilis seems to be strong. Other cases may possibly be due to infectious disease in the mother during pregnancy.

A not uncommon cause of paralysis in children is apoplexy from hemorrhage, thrombus, or embolism following one of the acute infectious diseases of children. In such cases the child, of course, is normal until it acquires either diphtheria, measles, whooping-cough, or similar disorder. The usual history is that either while convalescing or during the height of the disease convulsions occur, which may be limited to the affected side. Consciousness is lost for a time, and when regained the patient is found to be hemiplegic, and possibly, if the lesion is on the left side, also aphasic. The resulting condition is similar to hemi-

plegia following apoplexy in the adult, and frequently, which is not the case in the adult, epilepsy and imbecility result in addition.

It does not seem to be generally known that while one is most liable to apoplexy between the ages of forty and sixty years, exclusive of this period he is more liable to it during the first ten years of life than at any other time. Acutely developing paralysis following infectious disease is not always due to apoplexy, but may be due to inflammation of the cortical cells, or encephalitis. In addition, the cells composing the cranial nerve nuclei may be affected and also the cerebellum. In the former case there will be cranial nerve palsies; in the latter, ataxia in addition to paralysis of the limbs.

The distinction, at the time of onset, between apoplexy and encephalitis may be difficult. In the latter the onset may not be so sudden; there may be no loss of consciousness; headache and some rigidity of the muscles of the neck may be present.

An example of paralysis due to cerebral lesion following infectious disease is M. S., nineteen years of age. This patient was born after a difficult labor, but was normal until he was two years old. At that time he contracted what was said to be diphtheria. During convalescence from this disease he was seized with a series of convulsions lasting seven hours. When he regained consciousness he was found to be paralyzed on the left side. Ever since this time at varying intervals he has had convulsions of epileptiform type. At the present time his gait seems to be of the hemiplegic type. There are some contractures of the muscles of the left arm and inability to use the arm. The mental condition of the patient is fair and he has been able to make a living by selling newspapers.

If the brains of these patients, in which injury was due to birth accident or infection, are examined some years after birth the following may be found: Atrophy and sclerosis, either of a group of convolutions, an entire lobe, or of a hemisphere; porencephalus, meaning a cavity in the surface of the brain and cysts which may extend into the ventricles.

The diagnosis of meningeal hemorrhage at birth is very important, for, as we shall tell you later, something may be done

then to lesson the probability of permanent disability. Cyanosis of the head with convulsions, followed by coma, especially when subsequent to a difficult labor, is very significant. At the same time it must not be forgotten that this accident may also occur during easy labor.

The occurrence of these symptoms should lead to careful examining of the patient for any of the symptoms previously mentioned as being present immediately after birth. It must be borne in mind, however, that asphyxia after birth may be due to disturbance of either the fetal circulation, anemia from rupture of the cord, and possibly tetany and hydrocephalus. Later in life cerebral birth palsies may have to be distinguished from injury to the brachial plexus occurring during labor, the so-called *obstetric* paralysis or birth palsy of Duchenne. In this the disability is confined to one arm. If examined early there may be observed tenderness and swelling in the neck. Later the arm will be flaccid; the biceps-jerk and possibly the triceps will be absent, and the muscles will not respond to the faradic current as in cerebral palsy. The greatest weakness will be found in the muscles about the shoulder. In the cerebral palsies this is usually in the muscles of the arm and hand.

The athetoid and choreiform movements which have been described have been mistaken for Sydenham's chorea. It must be borne in mind that in not a few of these cases there may have occurred marked improvement in power and spasticity, and in such, if the physician is not extremely careful, the mistake will be made. Some evidence, such as the Babinski reflex, of damage to the pyramidal tracts will usually be found, and the history of the patient should make the case clear. In some cases of chorea there *may* be motor weakness, but this develops sometimes after birth, and when present the limbs are not spastic.

The atonic-astasic cases may be confounded with either myotonia congenita or amaurotic family idiocy. Both of these conditions appear, however, after the child is several months old. In the former the tendon-jerks are absent, and if the patient should be more than two years of age the Babinski reflex will be absent. In the latter condition there will be failure of

vision progressing to blindness, with the peculiar appearance of the optic nerve which is present in this disease. It is also a family disease most often occurring in Jews.

There is a possibility that acute anterior poliomyelitis may be mistaken for this condition, especially as cases have been reported in which the disease apparently occurred *in utero*. In these, however, the paralysis may involve only a group or groups of muscles. It is not apt to be hemiplegic or diplegic in distribution, and the affected muscles will be atrophied and flaccid and show a more or less developed reaction of degeneration. The tendon reflexes in the affected limbs will be diminished or absent.

The ataxic type may be mistaken for hereditary ataxia, either of the Friedreich or cerebellar type. In the former there will be nystagmus; the knee-jerks are absent; hyperextension of the toe is usually present. The disease develops at about fourteen to fifteen years of age, and has been frequently present in different generations of the family. In the latter optic atrophy will be present. Multiple sclerosis occurring in early life may present somwhat similar symptoms to the spastic type, but its development several years after birth is sufficient to exclude it. Hydrocephalus also may cause paralysis, either hemiplegic or diplegic. The development of the peculiar shape of the head, however, is sufficient to distinguish this condition.

A number of different forms of spastic paralysis, some of which are due to cerebral lesions and some to spinal, have been described, which in their symptoms resemble somewhat the spastic type of cerebral birth palsies. They are generally family diseases and may be either diplegic or paraplegic. They may develop in the patient at any period between the ages of several months and eighteen to twenty years. Mental deterioration is frequent, and optic atrophy, leading to blindness, nystagmus, paralysis of cranial nerves, ataxia, speech defects, and tonic or clonic spasm are symptoms. Some of these cases are due to a diffuse sclerosis of the cortex; others, to degeneration of the pyramidal tracts; in other words, are abiotrophies. The differential diagnosis between the spinal and cerebral types

may be impossible to make during life. Children attacked with these disorders are normal during the first few months or years. Some of the conditions may be due to hereditary syphilis. In many respects they resemble multiple sclerosis. The term "aplasia axialis extracorticalis congenita," or Pelizaeus-Merzbacher's disease, has been applied to a group of such cases in which a diffuse sclerosis is found after death. Krabbe has described a group somewhat similar to amaurotic family idiocy, or Tay-Sachs disease, which also belongs among these cases. This latter disease may develop some years after infancy.

Spina bifida occulta may cause paralysis in children. *x*-Ray examination will reveal its presence. Progressive lenticular degeneration or Wilson's disease causes spasticity of the limbs, speech defects, tremor, etc., without loss of muscle power. It does not develop until the child is several years old, sometimes seventeen or eighteen.

Cerebral paralysis following infectious disease may be mistaken for poliomyelitis. The history of onset is different. The muscles are firm and respond normally to the faradic current. The tendon-jerks are increased. The Babinski reflex is present. None of these symptoms are present in poliomyelitis. The fact that in the cerebral cases the affected limbs sometimes remain smaller than those of the normal side may lead to error, but attention to the occurrence of the symptoms just enumerated should make the case clear.

Multiple neuritis may also be the cause of paralysis following an infectious disease. In these cases, however, it is of the flaccid type. There is muscular atrophy and absent tendon reflexes, and, with the exception of the diphtheritic form, there will be tenderness over the affected nerves. In cases following diphtheria, tenderness and pain are usually absent.

Regarding the prognosis it may be said that if the child does not die during early life there is often a tendency to improvement, so much so that the paralysis may largely disappear. This is not the rule, and more or less disability is found in most cases. If epilepsy and mental enfeeblement occur, of course they are not recovered from, but they may be ameliorated by proper treatment.

The question of prophylaxis is of great importance in considering the group due to injury at birth. Statistics show that more cases result from prolonged labor than from the use of the forceps. Sachs, in his book on the Nervous Diseases of Children, writes that tedious labor is much more dangerous than the forceps, and that most cases occur in first children. Sharpe and Farrell, in their recent paper, say that prolonged labor should be avoided whenever possible, that the cesarean operation is less dangerous to mother and child than the high forceps. They also lay stress on the importance of carefully watching every child for symptoms and signs which have been mentioned as occurring early. In those cases in which the hemorrhage involves the convexity, early operation holds forth some hope of relief. Cushing in 1905 reported 4 cases of this kind operated on shortly after birth. He opened the skull and removed the clots. He got good results in 2. This has since been done by others with more or less success. As most of these patients either die soon after birth or are doomed to a life of disability and suffering, such operation seems to be justified when the diagnosis of hemorrhage can be made. It is true that some do not develop epilepsy and do not become mentally impaired. The motor disability may be slight, and in the hemiplegic cases especially the patient may be self-supporting. These instances, however, are very much in the minority. Lumbar puncture, which has been previously mentioned as useful for diagnostic purposes, may also be of considerable therapeutic value at this period. If evidences of distention should appear after puncture has been made, it should be repeated. Some excellent results have been obtained by this procedure.

Bearing in mind also the possibility of hereditary syphilis, Wassermann tests of the parents should be made, and if positive in either, proper treatment should, of course, be instituted. The majority of the cases which survive are due to involvement of the convexity, and Sharpe and Farrell, of New York, have operated on a number of selected cases of this type some time after birth. They consider the indications for their operation to be signs of increased intracranial pressure, as shown by papilledema and increased pressure of the cerebrospinal fluid

when removed by lumbar puncture, with a history of difficult labor and convulsions and asphyxia after birth. They opened the skull over the motor area on one or both sides, as required. In most cases meningeal cysts were found and the brain cortex is apparently healthy. In other words, the interference with function was due to pressure. The cysts were punctured, and their walls removed. Of 65 cases so treated there was marked improvement in 25. The youngest child was two and one-half years of age and the oldest seventeen. Nine died after the operation; 8 within two years; 19 showed no change, and 4 disappeared from observation. The authors state that the sooner the operation is done, the better is the outlook for improvement. Following the operation various mechanical and orthopedic measures must be employed as indicated.

Such measures may also be of considerable service in cases in which operation has not been done. Deformities may be relieved by lengthening tendons, by tenotomies, massage, muscle education, and electricity. In using the latter it should always be applied to the muscles, which are being overcome by their antagonists. Thus in the case of the arm the extensors should be treated and not the flexors. If the patient has convulsions of the Jacksonian type, exploratory operation is indicated. This to give hope of success must be done early, as the longer the convulsions continue, the more probably will the brain contract what is termed the convulsive habit, in which event the convulsions may continue even if the source of the trouble is removed. Cases in which the spasticity is great, and motor weakness not marked, may be relieved by the operation of rhizotomy, by which we mean cutting some of the posterior spinal roots. In the case of the legs this will be those of the lumbosacral plexus, and of the arms, the brachial plexus. By this means an artificial tabes is caused, with resulting hypotonicity of the muscles, and, while some ataxia may result, there is often considerable relief to the previous spastic condition and gain in the function of the limbs. The epileptiform convulsions may be limited in frequency by the usual treatment for epilepsy. Otherwise there is no indication for drugs in these cases except symptomatically.

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DIABETES

Clinical Determinations of Blood Sugar and Acidosis as Guides in the Management of Diabetes

The subject of our talk will be diabetes mellitus. This is a large subject, therefore I shall only discuss part of it today, namely, the significance of blood sugar and certain phases of acidosis.

During the past few years methods have been discovered for the determination of blood sugar and for the study of acidosis that not only require small amounts of material for the examination, but come within the scope of laboratory work which an internist might do.

If a case of glycosuria presents itself, one must first determine whether it is due to actual diabetes mellitus, or is to be classed as renal glycosuria, or as a consequence of head injury, drugs, or other possible causes. The chief differential diagnosis is between diabetes mellitus and renal glycosuria. This is especially so since our present methods of investigating glycosuria have shown that cases of renal glycosuria are more frequent than we previously supposed. The prognosis and treatment being different for each condition, correct diagnosis is paramount.

The determination of the blood sugar and urine sugar will best aid us to make this differentiation. In renal glycosuria the blood sugar is always within normal limits, and the amount of glucose appearing in the urine is not affected by increasing the carbohydrate intake. In diabetes mellitus when there is a glycosuria the blood sugar concentration is above normal, with

an exception or two, which will be discussed later. The blood sugar must reach a certain concentration before glucose appears in the urine, this concentration being practically the same in all normal individuals. Technically, this is called the threshold, a term indicating that concentration of glucose above the specified degree that will lead to excretion of sugar in the urine.

The limits of normal blood sugar, the influence of diet upon it, and the normal threshold must be understood before the proper interpretation of blood sugar values can be made.

A normal individual after starving at least six to eight hours will have a blood sugar concentration which will vary between 0.07 and 0.1 per cent. If the blood is examined one-half hour to two hours after eating a meal containing carbohydrates it will show values between 0.1 and 0.15 per cent., depending upon the amount of carbohydrate in the diet.

Hamman and Hirschmann[1] have shown that glucose does not appear in the urine until the blood sugar has reached a concentration of 0.17 per cent., which we will consider the normal threshold. In certain cases of diabetes we may have a lowering of the threshold, while cases complicated by nephritis may show an increased threshold. We will consider the blood sugar to be above normal, or that a hyperglycemia exists, when the concentration is above the normal threshold one to two hours after a meal containing carbohydrates, or above 0.11 per cent. six to eight hours after fasting.

Again returning to our case of glycosuria; if it is diabetes mellitus, what are the possible blood sugar findings, and when should we make the examination? Make an examination after the patient has fasted six to eight hours or, preferably, in the morning before any food has been taken. In mild cases we will find that the blood sugar may vary from the upper limit of normal to figures in excess of the normal threshold 0.17 per cent. If below the threshold value the urine at this time will probably be sugar free.

Having obtained the starvation level, it is advisable in some cases to determine the influence of carbohydrates on the level of blood sugar. This procedure is to be recommended if the

fasting level is below the normal threshold. In other words, test the carbodydrate tolerance. This is best done by examining the blood one-half hour to two hours after taking varying amounts of carbohydrate food or weighed quantities of glucose. Testing the carbohydrate tolerance is especially advisable in cases where the diagnosis is questionable. This will best be illustrated by the following 2 cases:

CASE I.—McC., a physician, while on duty at a naval base hospital in France developed symptoms of diabetes, including sugar in the urine. He was under treatment for diabetes in France, and recently returned to this country on sick leave. His basal blood sugar on the first examination at the University Hospital was 0.1 per cent. After taking 50 grams of glucose the blood sugar rose to 0.12 per cent. and no sugar in the urine. On the second examination, two weeks later, the starvation level was 0.1 per cent., and after taking a very heavy carbohydrate meal rose to 0.14 per cent. From the above results one would interpret that at the time of these examinations there was no apparent impairment of his carbohydrate metabolism. With the history of glycosuria, although there is no impairment at present, he should be observed regularly for some time.

CASE II.—F. L. B., a physician, was examined for life insurance and refused because of glycosuria. He frequently examined his urine thereafter and found it persistantly negative for glucose. It was then decided to determine his tolerance by giving 100 grams of glucose. After taking the glucose the blood sugar rose to 0.23 per cent. and sugar appeared in the urine. A normal individual after taking 100 grams of glucose should not have glucose in the urine nor have a blood sugar above 0.15 per cent. The patient, therefore, has a lowered carbohydrate tolerance. This is the counterpart to the so-called alimentary glycosuria. This patient and many similiar cases have an impaired carbohydrate tolerance, although the glucose only appears in the urine after taking very large amounts of carbohydrates. It would seem that they are cases of potential diabetes, particularly since we know that the continual overstraining of the carbohydrate metabolism will eventually lower the carbohydrate

tolerance, and possibly convert these cases from potential to active cases of diabetes. They need to be cautioned against partaking of large amounts of carbohydrates.

In the cases with a more limited carbohydrate tolerance and the severe cases we may find that the starvation level, particularly if the previous dietary restrictions have been lax, varies from just above the normal threshold to 0.5 per cent.

The vast majority of physicians in treating their cases of diabetes depend wholly upon the presence or absence of glucose in the urine as the gauge of the patient's tolerance. Since, however, better methods to determine that the patient is within the limits of tolerance are available, and at the same time can be done accurately by all physicians instead of a relatively limited few, it is important to discuss them. The Lewis and Benedict[2] method of determining blood sugar, or one of its modifications, such as Epstein,[3] meet these requirements. These methods require small quantities of blood, 0.5 to 2 c.c., depending on the method selected. The blood is obtained either by puncturing the finger or from a vein. The protein of the blood is removed by precipitating with picric acid solution and then either centrifuging or filtering. The clear filtrate is boiled with sodium carbonate solution, and the color thus produced is determined by a colorimeter, using a known standard solution of a pure glucose or picramic acid. In the Epstein method the colorimeter is patterned after the Sahli hemoglobinometer. The determination of blood sugar is of value as a guide in increasing the carbohydrate intake. This is especially so in the cases in which the tolerance is improving, and in the so-called cured cases.

After each increase in the carbohydrate intake the blood sugar should be determined one-half hour to two hours after eating to see if the added carbohydrate is within the patient's tolerance. This is best illustrated by the following case in which the carbohydrate in the diet has been increased from 70 to 200 grams without overtaxing the carbohydrate tolerance.

T. C., a boy nine years old, was admitted to the University Hospital in January, 1918, with glycosuria, a mildly positive ferric chlorid reaction, blood CO_2 59 volumes per cent., and a

hyperglycemia of 0.29 per cent. (after taking food). He was very quickly made sugar free and showed a fasting blood sugar of 0.09 per cent. With each addition of carbohydrate to the diet his blood sugar was determined, in most instances one to two hours after breakfast, and on several occasions after his midday meal. At no time did it go above 0.14 per cent. The blood sugar has been determined one or more times each month since the boy left the hospital, with the results stated above, except that in November, 1918, the blood sugar rose to 0.23 per cent. after the midday meal and glycosuria was present. In December, 1918, it rose to 0.18 per cent. and a trace of glucose appeared in the urine. On investigating the cause of the hyperglycemia the parents stated that they were no longer adhering to the diet and were permitting the patient to buy candy, ice-cream, and other carbohydrate-rich food.

Dr. S., admitted to the University Hospital in 1918 with an acute severe diabetes. At the height of the disease he eliminated as much as 16 liters of urine, 40 grams of ketones in terms of acetone, and rapidly lost weight. After a month's treatment he was made sugar free and his carbohydrate tolerance rapidly improved. His blood sugar was frequently determined during his stay in the hospital and never showed a hyperglycemia after he became sugar free. He learned to examine his own blood, and frequent examinations showed a normal glycemia until August, 1918, when, after an attack of influenza, a hyperglycemia and glycosuria developed. His carbohydrate tolerance on leaving the hospital in 1914 was about 30 to 50 grams, and gradually improved until 200 grams were taken without overtaxing his tolerance. He was readmitted to the hospital December, 1918, with glycosuria and a fasting blood sugar of 0.26 per cent. The history showed that he was apparently well until August, 1918, when his tolerance became impaired. He has very easily been made sugar free on a diet very low in carbohydrates.

We occasionally meet old cases of mild diabetes in which nephritis has insidiously developed and, as a result of the nephritis, the glycosuria has become markedly decreased and at times disappears. If we depend on the presence or absence

of glycosuria as the gage of the condition of such a case, we might be deceived, because, as the nephritis advances, the permeability of the kidneys becomes less. With the permeability of the kidneys decreased it becomes more difficult for the kidneys to excrete glucose. A higher blood glucose concentration is necessary before glucose appears in urine, or, in other words, a higher threshold for glucose occurs.

Occasionally in severe cases the threshold becomes lower and glucose may appear in the urine after blood sugar concentration of 0.13 per cent. is reached. Again, there are some cases in which it is not advisable to reduce the blood sugar to the normal starvation figures. In these cases, if the fasting blood sugar level is brought by dieting within normal limits and then more carbohydrate added to the diet, the rise of blood sugar may be out of proportion to the amount of carbohydrate added. This is due, as suggested by Mosenthal[4] and his coworkers, to the endeavor on the part of the organism to adjust itself to the increase.

Let us now discuss some features of acidosis, which is an important complication of diabetes that requires laboratory tests for its recognition and proper valuation. A severe acidosis is present in all cases of diabetic coma, therefore its early detection and prompt treatment is very important to prevent coma. Acidosis in diabetes is due to the accumulation in the blood of the intermediary products of fat metabolism, namely, beta-oxybutyric acid, diacetic acid, and acetone, which collectively are called the ketone bodies. Normally these products do not appear in the urine, or in such small quantities that they cannot be detected by the available qualitative methods. In cases of diabetes with any degree of acidosis we are usually able to detect diacetic acid by the ferric chlorid reaction. Throughout this talk the ferric chlorid reaction will be considered the most generally available for the qualitative detection of ketonuria. The best methods, however, for detecting acidosis are those which measure the alveolar CO_2 tension and the blood CO_2 content. The Marriott[5] method of determining the alveolar CO_2 is so devoid of the necessity of high technical skill that it can be accurately operated

by any physician. The Van Slyke[6] method for determining the blood CO_2 requires some practice, but the technic of its operation is readily acquired. The Marriott method for determining alveolar CO_2 tension can be conducted at the bedside. The Van Slyke blood CO_2 method requires a special gas buret devised for this test, a barometer, a high-speed electric centrifuge, and other minor pieces of apparatus, which, together with the financial outlay, will restrict its use to hospitals and to a relatively few physicians with well-equipped private laboratories. Accepting 60 to 70 volumes per cent. as the normal blood CO_2 and 40 as the normal alveolar CO_2 tension, any reduction in these figures is evidence of acidosis. Needless to say any increase or decrease of the blood CO_2 content or of alveolar CO_2 tension will tell us whether the acidosis is being successfully combated.

Many physicians use sodium bicarbonate in the treatment of the acidosis, while others oppose it, particularly Joslin.[7] He objects to its use on the following grounds: that it sets free acid bodies which are combined and harmless in the body, and thus does harm; its use over a long period of time may deplete the body of its necessary body salts, particularly sodium chlorid; it causes nausea and vomiting. Further, he holds that large quantities of urine must be voided to remove the salts of the acid. This causes the ingestion of large quantities of liquids, overloading the stomach, and the excretion of much acid, which frequently overwhelms the kidneys, causing them to cease to act. The constant use of an alkali appears to promote the constant excretion of acid bodies in some cases. When the alkali is withheld the ketonuria disappears, only to reappear on the use of alkali. Sodium bicarbonate is unquestionably contraindicated in some cases, but, on the other hand, its use is most beneficial in certain cases. Theoretically, it would seem that the use of sodium bicarbonate is the logical treatment for the following reasons: bicarbonate of soda is the main buffer substance which neutralizes the foreign acids that accumulate in the blood. Therefore acidosis has been defined as any decrease in bicarbonate reserve in the blood. The administration

of bicarbonate of soda replenishes the depleted bicarbonate reserve.

When sodium bicarbonate is used in the treatment of acidosis the determination of the alveolar CO_2 tension or the blood CO_2, preferably the latter, are the best indices to determine whether sufficient sodium bicarbonate has been given. It is known that excessive amounts of sodium bicarbonate do more harm than good. Formerly the presence of an alkaline urine was the signal that sufficient alkali had been given. It has, however, been demonstrated that in many cases of diabetes the kidneys are not normal, and that the urine in these cases does not become alkaline until the blood bicarbonate reserve is far in excess of normal. Cases have been reported in which sodium bicarbonate has been given in such quantities to create a state of alkalosis with tetany before the urine became alkaline. Therefore when sodium bicarbonate is used do not depend on the reaction of the urine, but on the blood CO_2 content. If the blood CO_2 is normal and the urine acid, disregard the latter. If the blood bicarbonate has been raised to normal and the urine still shows ketones, do not think that you have successfully combated the acidosis and that the danger of coma is past. Occasionally sufficient sodium bicarbonate will be given to raise the blood CO_2 to normal, but the patient nevertheless may die in coma.

Physicians who do not use bicarbonate of soda in the treatment of diabetic acidosis would not experience this condition, but would find a low CO_2 reading. A normal blood CO_2 reading with a negative diacetic acid reaction is what we should strive for. In cases of acidosis it is advantageous to determine the alveolar CO_2 tension or the blood CO_2 content daily.

The object of this talk has been to outline the use of those tests which are within the reach of all clinicians. With the employment of tests for studying the blood sugar, urine sugar, blood CO_2 content, or alveolar CO_2 tension, and the use of the ferric chlorid reaction for the detection of diacetic acid the physician has in his possession the important methods for the proper treatment of diabetes along modern lines.

Of course, if he is able to make or obtain quantitative deter-

minations of the ketone bodies in both the blood and urine, the urinary ammonia nitrogen, the total nitrogen of the urine, and the blood lipoids, etc., it is a further advantage.

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X-RAY DIAGNOSIS OF LUNG DISEASES

A Presentation of Cases with Typical Findings, and of Others in which Clinical Findings are Proved Incorrect.

WE have arrived at the point where it is quite proper to say that there is no intrathoracic condition in which the diagnosis may be considered complete if *x*-ray study has been omitted. In very many instances *x*-ray study will be found to have furnished the most important data for diagnosis, and in not a few cases it will be found that it has not furnished vitally important information, but that no part of this has been revealed by other clinical methods.

Why then has it not been more commonly employed? The answers are many, but all are included in one—lack of understanding.

Beginning with the scant attention given to roentgenology in medical colleges, we are further confronted by the fact that the majority of monographs and papers upon general topics in medicine are still written by men who have had but little training in, or experience with, roentgenology, and that there is still an exceedingly large percentage of patients whose medical care is entrusted to physicians who know but little of the possibilities of *x*-ray diagnosis. As prolonging this condition there has been an attitude of self-satisfaction on the part of the clinician and a lack of aggressiveness on the part of the roentgenologist.

Until recently, at least, one might be justified in classifying roentgenologists in two principal groups; the one absorbed in the scientific detail of the fascinating study and having little inclination and less time for propaganda; the other, a larger class,

those who for one cause or another have occupied inferior positions both as to hospital and private practice. Much valuable contribution from this class has had limited distribution.

All this now becomes a matter of history. At the various training camps, but particularly at Camp Greenleaf, the value of roentgenology has been so efficiently taught that we may confidently expect to see this method come into its own with a rapidity quite out of keeping with its, until now, rather slow recognition.

The complete study must be fluoroscopic as well as roentgenographic. It is our practice to examine every thorax patient fluoroscopically before making plates. Beginning at the apices we observe whether the aëration is equal on both sides both with ordinary and forced breathing. Then with the diaphragm set to illuminate a horizontal strip of screen from 1 to 2 inches wide we sweep slowly downward over the entire chest looking for unequal aëration. If such areas are found they are carefully studied with large and small diaphragms. Next the arch of the aorta is observed, both in anteroposterior and oblique positions, for dilatation or aneurysm. The auricles and ventricles of the heart are then studied. The left auricle and both ventricles are normally easy to distinguish, while the right auricle if hidden is easily observed in the semi-oblique view. No physical sign of pericardial effusion appears so early as does the fluoroscopic sign, which is naturally the obliteration of the normal auricular and ventricular curves. Finally, the action of the diaphragm—its excursion—is observed, the right dome being normally higher than the left and its excursion more limited. The presence or absence of limiting adhesions and their extent if present are noted, and lastly, the presence of small quantities of fluid, not sufficient to attract attention in the first survey, will be noted by the obliteration of the angle between the diaphragm and the outer chest wall. The chance of error in the detection of even small amounts of fluid is slight if the observer is at all careful. Adhesions may simulate it, but their level does not vary with the acts of respiration. We have seen the dome of the diaphragm obliterated by adhesions which drew it to a tense horizontal line,

but here also is the absence of excursion, and there is little or no change by posture as would be the case with fluid. When the patient may not assume the erect posture, even momentarily, the detection of small amounts of fluid is less easy, but by alternate examinations with the patient now on the left side, and now on the right, a fairly accurate diagnosis even as to amount of fluid is usually obtainable.

In roentgenology many signs are plainly definite. Pleural effusion, pulsating aneurysm, diaphragmatic adhesions, cardiac displacement, foreign bodies—of these one speaks as confidently as he does of meeting an acquaintance. There is no ground for debate. But, is a given case just a slowly resolving pneumonia, or is there an engrafted tuberculosis present? Is this, evidently old, tuberculous lesion entirely quiescent, or are there areas of present activity, etc.? In a multitude of these and other cases only the most careful team work can give results at all to the patient's advantage.

An effort is made to present here cases of especial interest to the general practitioner, cases which may originate in any family practice. Particular attention is paid here to cases which are distinctly typical and to those in which the clinical diagnosis was quite disproved. The name of the clinician is omitted in some of these latter cases because of unpleasant inferences that might be drawn. These clinicians were men of more than average ability, and the errors are, I believe, unavoidable and furnish the strongest argument for the intelligent use of *x*-ray study in thoracic disease. By intelligent use is not meant that either the clinician or the roentgenologist shall accept the opinion of the other, but that the two by persistent "team work" shall arrive at a well-understood working basis.

Case I (from the service of Dr. Arthur Newlin, Pennsylvania Hospital).—A. S.; female, æt. sixty-four. Diagnosis: pleural effusion. Family history, negative. Personal history, negative up to six months ago, when left breast was removed for a malignant growth. Began six days ago with shortness of breath, choking sensation, weakness, sweating, loss of appetite, dry cough, no chest pains.

Examination.—Right side, flatness with increased resistance; diminished vocal resonance and fremitus and breath sounds. Breath sounds over upper portion exaggerated and note slightly tympanitic. Lateral and anterior aspect of lower two-thirds of right chest shows many crackling râles, a few sibilant râles, bronchovesicular breathing. Left chest, negative.

Fig. 152: *x*-Ray examination. Typical, rather excessive, right-sided pleural effusion. This effusion and the shadow of the breast effectually block out all other detail. Normal lung

Fig. 152.

Fig. 153.

shadows above the effusion are accentuated, but not more than can be logically explained by the lung compression. There is a very distinctly thickened interlobar pleura on the left side. Any suggestion regarding the original lesion causing the effusion is quite impossible.

Fig. 153: Fourteen days later. The fluid does not reach nearly as high as in the first examination. Conditions are otherwise unchanged.

Fig. 154: Six months later. On the left side there remains unchanged the thickened interlobar pleura. There are also

dense pericardial diaphragmatic adhesions with marked abnormal density in the lower portion of both lungs and accentuation of the peribronchial shadows in the upper part of both lungs. These findings are not particularly significant of malignant disease. [In this case it seems quite probable that the effusion was not due to metastasis, as would naturally be suspected.] Figures 152 and 153 are quite typical of any pleural effusion which is not walled off and which is not accompanied by pneumothorax. This is an appearance very easily recognizable not only in plates, but in the fluoroscope, and in the fluoroscope the diagnosis can be almost instantly verified by changing the position of the patient. It is to be noted particularly that the contour of the

Fig. 154.

fluid does not assume a level as is the case whenever pneumothorax is present.

CASE II (service of Dr. Arthur Newlin).—D. B.; male; æt. thirty; Italian; laborer. Provisional diagnosis: acute pleurisy, chronic endocarditis. Family history, negative. Married three years; wife and two children living and well. There is occasional alcoholism, moderate use of tobacco; indoor occupation. No previous illness. Not predisposed to colds. Has had slight unproductive cough for a year or more.

Present illness began one day ago, with a series of chills; sharp pain in right side of thorax anteriorly, increased by deep breathing or coughing. Cough productive and toward evening

sputum became blood streaked. There was shortness of breath and fever.

Fig. 155: *x*-Ray examination. Plate taken with patient reclining. Large right-sided pleural effusion. Plate typical in the reclining position.

Fig. 155.

Fig. 156: Two days later, after partial aspiration, during which air had been admitted to the chest. The patient im-

Fig. 156.

mediately previous to this examination had been reclining. He was placed in the erect posture and the plates rather hurriedly

made. Note three areas of pneumothorax each above a level area of fluid. This interesting condition was undoubtedly temporary and produced by placing the patient in the erect posture.

Fig. 157: Examination at the end of six weeks just previous to discharge shows some remaining accentuation of the hilus shadows, a distinctly thickened right interlobar pleura, but, on the whole, quite confirming the clinical appearance that the patient has practically recovered.

Fig. 157.

More or less closely associated with pleural effusion and empyema unrestricted on one side of the thorax are the cases of encapsulated or walled-off empyemas.

Case III (from the service of Dr. Arthur Newlin, Pennsylvania Hospital).—A. B.; male; æt. forty-four; oyster opener. Provisional diagnosis: acute pleurisy. Complained on admission of sharp pain in right side of chest, increasing in severity on both inspiration and coughing. Family history, negative. Is a moderate drinker; uses tobacco excessively; has been an oyster opener for twenty years. Had typhoid fever at the age of nineteen; several infections of the hands and some chronic arthritis. Present illness began suddenly twenty-four hours ago with

severe pain in lower right side of chest, mostly anteriorly. Had slight cough for past two or three days only, non-productive; no blood spitting. There has been no loss of weight. During the following two weeks the subjective symptoms decreased, but there was very rapid loss of weight.

Fig. 158: Examination shows a typical, parietal encysted empyema, probably originating between the upper and middle right lobes and gradually assuming the pendulous position here shown. The patient was at once drained through a resection of the sixth rib. A large quantity of thick light green pus of foul odor, but in which the colon bacillus was not detected, was

Fig. 158.

removed. Recovery was prompt and complete. Surgeon, Dr. Richard H. Harte.

Case IV.—W. C.; male; æt. forty; laborer. Provisional diagnosis: pulmonary abscess. Family history, negative. Personal history, typhoid fever at twenty-eight years; takes cold easily; denies venereal infection; uses whisky and tobacco to excess. Four months ago while at work sat down to rest, when he had a sudden coughing spell, which produced a hemorrhage of about a teacupful. Later there were two similar hemorrhages. During this time his weight has decreased from 172 to 135 pounds. He expectorates a large amount of greenish sputum; has no

night-sweats; appetite is good. Patient is pale, poorly nourished; decided clubbing of fingers; slight cyanosis of finger-tips; chest is flat. Expansion is equal anteriorly. Posteriorly, greater play of left scapula than of the right. Percussion gives slightly higher pitched note at right apex than at left. Note throughout rather woody in character, with impairment at right base extending around to right lower axilla. Vocal and tactile fremitus are normal. A few fine râles heard in extreme right apex, right base, and left lower axilla. Percussion note impaired at extreme right base posteriorly.

Fig. 159.

Fig. 159: x-Ray examination fifth day after admission. There is a large area of great density opposite the seventh interspace posteriorly, fourth interspace anteriorly, right side. This area is surrounded by an area of diminishing density which reaches to almost every part of the right lung. Considering the location and the rather sharply defined curved borders this would seem to be an encapsulated interlobar empyema rather than a lung abscess. There is some thickening of the parietal pleura at the level of and below this area.

Fig. 160: x-Ray examination fifteen days later. There is comparatively little change. The mass before reported seems a little smaller; the density of the surrounding lung, especially above the mass, a little less. The mass does not show any area

of lesser density, as would be the case if it were an abscess partly

Fig. 160.

empty and filled with air. [During this period and the two weeks following the patient's condition improved perceptibly. There

was especially a great diminution in the cough and an almost complete cessation of the putrid sputum.]

Fig. 161.

Fig. 161: A third examination three weeks later shows the mass somewhat smaller, the surrounding hyperplasia very defi-

nitely reduced, and, by stereoscopic study, the mass is apparently equidistant from the anterior and posterior walls. The diagnosis of encapsulated interlobar empyema would seem to be positive. The patient was drained through an open incision three days after the last *x*-ray examination. It was necessary to go a considerable depth into the lung tissue, and the operative diagnosis between a lung abscess and interlobar empyema was not made. The patient developed pneumonia, apparently septic, on the tenth day after operation, and died on the thirteenth day subsequent to operation. Combining the clinical history with the *x*-ray findings it would seem that this patient had an interlobar empyema which was preceded by a lung abscess of some three or four months' standing.

Fig. 162.—(Reversed.)

Case V (service of Dr. Arthur Newlin, Pennsylvania Hospital).—L. W.; female; colored; æt. thirty-seven; domestic. Family and personal history, negative. Has had for a few days pain in the upper right chest, some dyspnea, loss of appetite, general malaise. By examination the mediastinal dulness extends some three fingerbreadths to the right, and in the same area there is diminished breath sounds, vocal resonance, and vocal fremitus.

Fig. 162: *x*-Ray examination shows typical walled-off mediastinal empyema which was drained by open operation.

Operative diagnosis: apical empyema. Discharged cured. Surgeon, Dr. Richard H. Harte.

CASE VI (patient of Dr. George W. Norris).—Spontaneous pneumothorax. Male, aged about thirty-five years. Previous history of tuberculosis, with apparent recovery twelve years before.

Fig. 163: On the day previous to this examination patient awoke in the morning with a feeling of distress in the right chest and slight shortness of breath; otherwise without symptoms.

Fig. 163.

This plate was made after clinical diagnosis of pneumothorax. Note the partially collapsed right lung showing adhesions at the apex which prevent its entire collapse, showing also very plainly division between the middle and lower lobes.

Fig. 164: The second examination five days later shows considerable expansion of the collapsed lung, but a hydropneumothorax. Examination of similar cases with fluoroscope is highly satisfactory, the slightest movement of the patient being shown to cause waves in the fluid, making its recognition prompt and easy.

What is much more surprising is the rather more than occa-

sional error in which a collapsed lung with pneumothorax is mistaken for a large pleural effusion. This, in our experience, has occurred too frequently to be counted as an accident or explained solely by the negligence of the clinician. It apparently depends upon the same principle of sound modification as does the change in the tone of a drum when its air vent is closed. The ruptured lung, acting with a valve effect, permits overdistention of the involved side of the chest.

Fig. 164.

As in this case (Fig. 165, from the *x*-ray service of Dr. W. F. Manges, Jefferson Hospital), where the left lung is shown totally collapsed in a position in which it might almost be mistaken for an enlarged shadow of the left auricle, the heart and aorta are shown markedly displaced to the right. The collapse of the lung is confirmed by the total absence of lung detail throughout the right chest which is especially marked when compared with the increased lung detail in the right chest. In this patient there was, clinically, decreased expansion of the left side, diminished vocal fremitus amounting almost to absence, accompanied by tendency to hyperresonance with slightly increased fremitus over

the right side. The percussion note on the left side somewhat

Fig. 165.

impaired; breath sounds almost entirely absent. Breath sounds on the right side harsh, with occasional râles.

It is not my purpose in this clinic to enter into the discussion, pro and con, of the *x*-ray diagnosis of pulmonary tuberculosis. A single case is shown as an example of the many in which the progress of the disease, while extensive, has been so insidious as to escape the notice of the patient or his family. Frequently, as in the present case, the progress of the disease as shown by *x*-ray is quite out of proportion to the clinical findings.

Case VII (service of Dr. Arthur Newlin).—This patient, K. I., female, eleven years of age, was admitted on account of abdominal pain. The father died of tuberculosis. Mother, one brother, two sisters are well. Pertussis three

Fig. 166.

years ago. One short attack of bronchitis a year ago. Otherwise well until present illness. For the past three weeks ill with abdominal pain, especially after eating. Nausea, vomiting, headache, cough for the past week; slight expectoration. Examination of lungs anteriorly: Impaired note at both apices and below clavicles to second interspace; increased tactile fremitus, exaggerated vocal resonance; prolonged high-pitched expiration; no râles. Posteriorly, dulness on right over summit to 15 cm. downward. Tactile fremitus increased; prolonged high-pitched expiration; egophonine voice sounds. Left side, posteriorly: impaired note at apex and 10 cm. downward.

Over summit, prolonged high-pitched expiration; occasional crackling râles.

Fig. 166: Extensive increase in density throughout both lungs. This is at a maximum on the left side between the fourth and sixth ribs in the axillary line, and there is rather less density shown in the lower and external portions of the right lung. Running from the hilus toward both apices are cavities which have more an appearance of bronchiectasis than necrosis. The examination is highly characteristic of an advanced tuberculosis of comparatively slow growth. [This finding was borne out by the further clinical history and the death of the patient.]

One of the most frequent metastases of sarcoma is metastatic sarcoma of the lung.

CASE VIII.—This case is exceedingly typical, not only as to the *x*-ray finding, but as to clinical symptoms. G. P., male; æt. twenty-two; Italian, laborer; admitted October, 1913, with sarcoma of the left forearm. Had been operated January, 1912, in Italy. The tumor began to grow again; the arm became painful, but on admission the growth was limited to the forearm; the elbow was not involved; there was no involvement of the axillary glands, and removal was done without amputation. Pathologic diagnosis: spindle-celled sarcoma. Treated with Coley's fluid for five months; discharged; returned for Coley's fluid and observation. Readmitted May, 1914, with severe pain in forearm. There was a return of the local growth, but no indication of metastasis. Lung examination was apparently negative, though there is a note made of slight mucopurulent expectoration. The patient was given Coley's fluid and *x*-ray treatment.

In August, 1914, the arm was amputated at the shoulder. Pathologic diagnosis: round-cell sarcoma. Patient was placed under postoperative *x*-ray treatment. During the next six months the patient did odd jobs around the hospital, running the elevator, doing orderly work, etc. He was in constant communication with the staff, and was more or less of a hospital pet. There was no return of the growth locally. The

patient was apparently well, and made no complaint until the day before this examination.

Fig. 167: At this time he complained of rather severe pain in the chest which led to the clinical examination followed by *x*-ray study. There are to be noted three very large masses in the left chest, one of which overlies another, and there are to be counted in the original plate thirteen separate foci of metastases. When the condition and its inevitable result were explained to the patient he returned to Italy. This case is particularly typical in the large degree of involvement without subjective signs.

Fig. 167.

Case IX (service of Dr. Arthur Newlin, Pennsylvania Hospital).—In some respects this case is similar to the preceding. F. P., æt. twenty-two years; Italian. The patient had had amputation of right leg above the knee eleven months previously for osteosarcoma. One month after this operation right inguinal glands were removed, but no metastases found. The present trouble began a week ago with chills, fever, swelling of hands, arms, legs, and with aching pains in these parts. Sharp pain in left chest, slight pain on the right side; no dyspnea, no palpitation; some cough at night; no expectoration, no hemoptysis. The patient states he has lost considerable weight; exact amount

not known. Has never noticed the change in fingers (clubbing) until pointed out to him. Lung examination: Expansion fair and equal. Vocal fremitus good, except in right axilla below sixth rib, and posteriorly in left below inferior angle of scapula. Percussion over right lung negative. Left lung anteriorly, resonant with dulness below seventh rib in left axilla; dulness below inferior angle of scapula posteriorly. Breath sounds and vocal resonance decreased in these areas.

Fig. 168: *x*-Ray examination shows pleural effusion on the left side reaching to the third rib anteriorly. Above this there

Fig. 168.

is a mass about $1\frac{1}{2}$ inches in diameter underneath the anterior end of the second rib. This is quite typical of secondary lung sarcoma with effusion. Examination was made of all the long bones in the body with the result practically identical with that of the right hand.

Fig. 169: Periosteal proliferation is to be noted in every one of the long bones, except only the distal phalanges. The same condition was found in the feet, neither the carpus nor the tarsus being involved. There was no perceptible involvement of the cranial bones. During the remainder of the patient's

life, about six weeks, there was no apparent increase in this condition, nor was any bone change noted at all typical of sarcoma. Clinically, a case of osteo-arthropathy pulmonique (Marie). The very unusual feature was the apparently rapid development of this condition, previously reported cases being of slow development and long duration, apparently always accompanied by chronic pulmonary disease.

Fig. 169.

In conclusion I wish to present briefly two cases as typical of a considerable and rapidly increasing number of a condition usually diagnosed as chronic bronchitis, sometimes as incipient tuberculosis, but really due to unsuspected foreign body. For the privilege of exhibiting these cases and as well, indeed, for the privilege of examining all similar cases which I have seen, I am indebted to the courtesy of Dr. Chevalier Jackson.

Case X.—V. M. S., female; æt. thirty-eight; eight years ago began to be troubled with cough; once a week would expectorate a mass of material the size of a pea, cheesy consistency, greenish-brown in color, and of foul odor. She was thoroughly examined in a western city; no evidence of tuberculosis was found; the sputum was examined. The patient led an outdoor life for the next two years. It was then necessary to have a perineorrhaphy

performed. The patient went to her home in an eastern city,

Fig. 170.

where, in the course of the general examination, an *x*-ray study of the chest was made, and a report given of an open safety-pin

in the right bronchial region. She was advised to "leave the pin alone as long as it leaves you alone." The cough gradually increased in severity and frequency, and masses, as above described, were expectorated more frequently. In the latter part of May, 1918, the patient had the first pulmonary hemorrhage, and a week later a second. Hemorrhages occurred very frequently from that until the time of admission in August. The amount varied from 6 to 16 ounces. Her family physician considered the case one of tuberculosis, disregarding the history of the safety-pin in the lung except as a possibly aggravating factor. The patient was brought from Florida to Philadelphia for examination by Dr. Jackson. She arrived in a stuporous condition, coughing up blood-streaked sputum.

Fig. 170: This plate was made some six hours before the patient's death. Neither she nor her family had any knowledge of the circumstances of the aspiration of the foreign body.

Case XI.—D. M., male; æt. eight years. When two and a half years old while seated at the dinner table he suddenly spat up a mouthful of blood. An attack of "bronchopneumonia" lasting one week followed. A severe cough productive of a purulent expectoration followed, and at irregular periods the child spat blood in amounts varying from a mouthful to sputum which was merely blood streaked. For about two years, or until aged four and a half years, these symptoms continued in great severity, finally decreasing and the hemoptysis ceasing. The cough, however, continued, and there was purulent expectoration at intervals. There has never been a septic temperature; no night-sweats, but the child failed to grow strong. Repeated examinations were made for tuberculosis. Reports upon the sputum were always negative. At about the middle of the eighth year the father of the child, a physician, made an *x*-ray examination of the chest and discovered a foreign body in the lower right lobe. Two bronchoscopic examinations under ether anesthesia were made at an interval of about one week. In both there was failure to secure the foreign body and the patient was returned to his home. Some four months after the last bronchoscopic examination the patient was referred to Dr. Jackson.

Fig. 171: At this time the x-ray examination showed a metallic foreign body in the base of the right lung. In the fluoroscope the diaphragm shadow was seen to rise so as to completely cover the foreign body and fall so as to completely clear it. The foreign body is slightly less than $\frac{3}{4}$ inch in length and about $\frac{1}{4}$ inch in diameter at its upper large and blunt extremity. From this it tapers to a rounded point. A guess was made that it was the steel tip which fits in a tubular umbrella stem. There

Fig. 171.

was strikingly little surrounding pathology to be seen—just a slight increase in density immediately around the foreign body. The body was removed by Dr. Jackson by oral bronchoscopy under fluoroscopic control. The recovery of the patient, as in every one of these cases in which the foreign body has been removed, was prompt and complete.

These cases seem to be strikingly out of keeping with ordinary clinical experience. To the average layman or physician the aspiration of a foreign body in the lung

is an occurrence of such critical importance that the idea of an unsuspected foreign body in the lung seems almost preposterous. As a matter of fact, however, once the foreign body has passed through the trachea and into the bronchus, the relief from distressing symptoms is just as immediate and frequently as complete as if the foreign body had been expelled upward, and if *x*-ray examination of the lung had no other use than to reveal the presence of a foreign body in numerous cases of chronic bronchitis of unknown origin, its routine use in lung examinations would be fully justified.

Conclusions.—1. *x*-Ray study is exceedingly important in the general diagnosis of lung conditions.

2. The data yielded by this method are frequently such as can be obtained in no other way.

3. The valuable aid to be obtained by this method is, even yet, not generally understood, nor, so far as the average patient is concerned, generally used.

4. Its use in pleural effusion, whether free or walled off, is immediately and decisively satisfactory.

5. In tuberculosis and many other lung involvements, lesions, as revealed by *x*-ray, are very frequently more extensive than other clinical methods would indicate.

6. If for no other reason than to eliminate the question of unsuspected foreign body, this method should be used routinely in the clinical examination of the thorax.

7. The error of mistaking an excessive pneumothorax for a pleural effusion is not impossible even among clinicians of wide experience.

CONTRIBUTION BY DR. S. D. W. LUDLUM[1]

PHILADELPHIA HOSPITAL

PHYSIOLOGIC PSYCHIATRY

EVERY psychiatric clinic has had experience with cases typical of mental disorders which are generally considered incurable; when they do recover it is just as unexplainable as it is unexpected. We have been interested in cases of this sort, many having had all the signs and symptoms of dementia præcox; such cases as you would ordinarily decide would completely dement.

One of these cases, a young woman, began to improve phenomenally after beginning a treatment consisting largely of dilute hydrochloric acid, and within three months was totally well, and has remained so for two years. This girl had been having a continuously alkaline salivary secretion, occasionally an alkaline urine, and usually an acid stool. All these observations are quite opposed to the normal reactions, which are saliva alkaline before meals and acid afterward, urine acid, stool alkaline, blood nearly neutral. Following this case we have been making continuous observations upon newly admitted patients as to whether they were acid or alkaline in saliva, urine, blood, stool, and perspiration; and we have, I think, come upon some very interesting things.

In a large clinic like this, which is more of a clearing-house for the city's mental deficit than it is a treating hospital, it has appeared that if we disregarded the alcoholic and syphilitic, and tested those having the ordinary psychosis, we had frequently two groups—an alkaline and an acid group. This was not true of cases admitted where the condition had been of long standing,

[1] From the Psychopathic Department of the Philadelphia Hospital and the Laboratory of the Gladwyne Colony.

but was true of many acute cases. It seems that a disease having been existent for some time reaches a sort of pseudo-equilibrium; the observations made here have been based on the cases of short duration.

Quite early in this study the work of Loeb came to mind because of its close biologic relationship. In his book, "Dynamics of Living Matter," he shows the importance of a "regulator which is capable of keeping the solution in which marine animals live neutral." The cases that we have studied also have considerable analogy to the rapid modification of the behavior of fishes by contact with modified water; modified by altering its degree of acidity or alkalinity. Work of this sort has been done by Shelford and Allee in the Zoölogical Laboratory of the University of Chicago. Shelford says, "protoplasm and the plasmas of organisms possess a definite mechanism for maintaining approximate neutrality." Henderson says, "neutrality is quite as definite and quite as fundamental and quite as important a characteristic of the organism as is its temperature or osmotic pressure or, in fact, anything else we know of."

In the Journal of Physiology in 1890 we find that Roy and Sherrington give the results of their experiments upon circulation of the brain following intravenous injections of various substances. The substances having the most appreciable effect were acids and alkalies—acids raising blood-pressure and congesting the brain, alkalies lowering the blood-pressure and creating a brain anemia. The osmotic tension was undoubtedly different in each group.

There is quite enough biologic and physiologic data to assure one of the necessity of establishing neutrality or chemical balance in the nervous patient as a most fundamental procedure, and, following this, of establishing the physiologic balance. We have a number of such cases on record in these wards, and we become more and more impressed with the idea that mental disorder is but an expression of the visceral state. If this is so, it is quite surprising that so much has slipped past the internist. To illustrate, I shall give below in detail two examples—an acid and an alkaline case.

As a side light on the form that a psychosis may assume an article by Dr. Wm. B. MacNider appeared in "Science" last year concerning the influence of the age of an organism in maintaining its acid-base equilibrium. From the experiment cited it would appear that there is a definite association between the toxic effects of uranium and its ability to induce an acid intoxication; and the age of the animal very largely determines the rapidity of development and the severity of the intoxication. When animals of different ages were intoxicated by uranium the age of the animal was expressed by the degree of its ability to maintain the acid-base equilibrium. So it is possible that an acidosis or a pus-pocket in one individual gives an expression of a certain psychosis which in an older individual would produce a different psychosis.

The two cases which follow I consider typical examples of a departure from neutrality in opposite directions. One an alkaline state and the other an acid condition. Both cases made a prompt recovery when neutralizing substances were given as medicine, and the food selected to leave the appropriate acid end-products or alkaline residues as the case required.

Case A.—A woman forty-seven years old, still menstruating, with the mental condition of excitement such as we see in manic-depressive insanity. She became sick rather suddenly, and went into this condition of manic symptoms. It was difficult to get her to sleep and more difficult to keep her in bed. The blood-pressure ranged about 190. She was in this condition for six weeks before we discovered that all her chemical symptoms grouped together. With litmus paper her saliva was invariably alkaline. The urine was very often alkaline on passing (she had no cystitis). The stool was often acid. The perspiration was sometimes acid, sometimes alkaline. The H-ion in the blood showed a figure indicating the low limit of normal, and the alkali reserve tests showed a high border of the normal. Van Slyke's CO_2 test showed a high normal. The teeth were bluish in color, suggesting poor lime metabolism, and the lime recovered in the urine was in excess of normal; evidently she was not taking care of her lime.

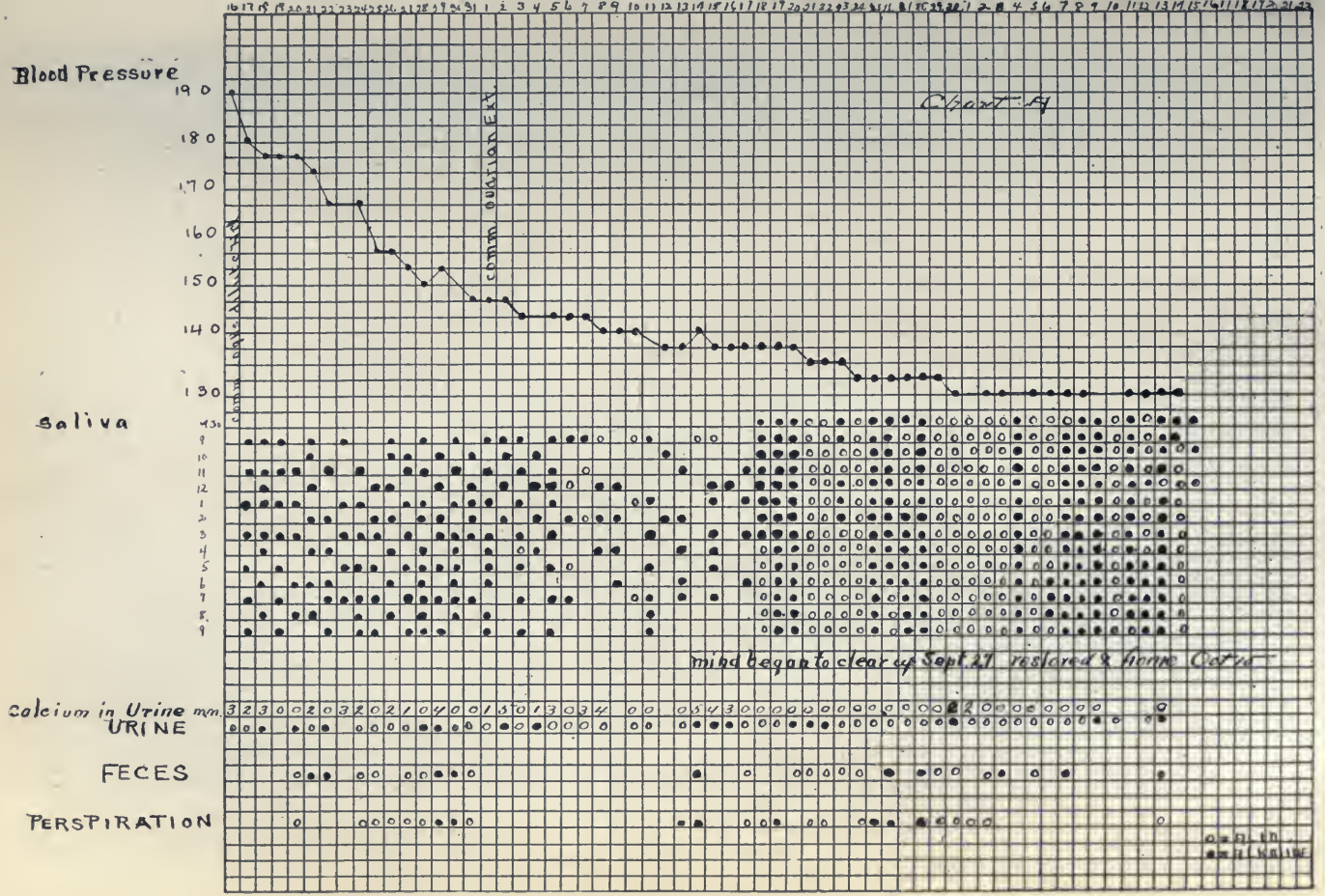

Fig. 172.—Case A.

The chart indicates the case at the point where dilute muriatic acid was given as medicine, and it is interesting to note the progressive lowering of her blood-pressure. Tablets of ovarian extract were given because it has proved useful in the high blood-pressure cases with excitement. The chart shows in the course of three weeks the beginning of acid salivary reactions, until finally the observations demonstrated in the same day both acid and alkaline salivary reactions. At the same time it is noted that her blood-pressure had become normal, that the calcium was excreted in the urine to a less extent, and that the bowels showed less variations (normally the feces should be alkaline). The mental symptoms had all disappeared by this time and the patient was discharged.

Case B.—A woman with the acid diathesis, with mental symptoms of confusion. She had been previously recommended for the asylum, but she has made a very good recovery. Her blood-pressure was low, the saliva invariably showed acid reactions with litmus. The urine was often alkaline, the stool usually acid. The H-ion showed a high normal content, the alkali reserve a low normal, the Van Slyke CO_2 a low normal. The calcium excretion was limited, but came up as she improved. She was given sodium bicarbonate daily to establish neutrality, and for the physiologic symptoms was given suprarenal tablets, which raised her blood-pressure. When she showed in the same day acid and alkaline litmus reactions in the mouth, when the blood-pressure had come up, and her other body cavities were giving normal reactions, so that one might expect proper osmosis to take place, she became sufficiently well to go home.

Many critics say that litmus is not a delicate enough test, but it always tallies with the collection of dialized saliva tested against color tubes, and for clinical purposes it is quite sufficient.

The condition of caries in the teeth has little to do in determining the reactions, for in these cases the teeth were the same throughout the period of observation.

I think that the practising physician can do a great deal toward caring for his nervous patients and often prevent their insanity by seeing that the fluids, secretions, and excretions

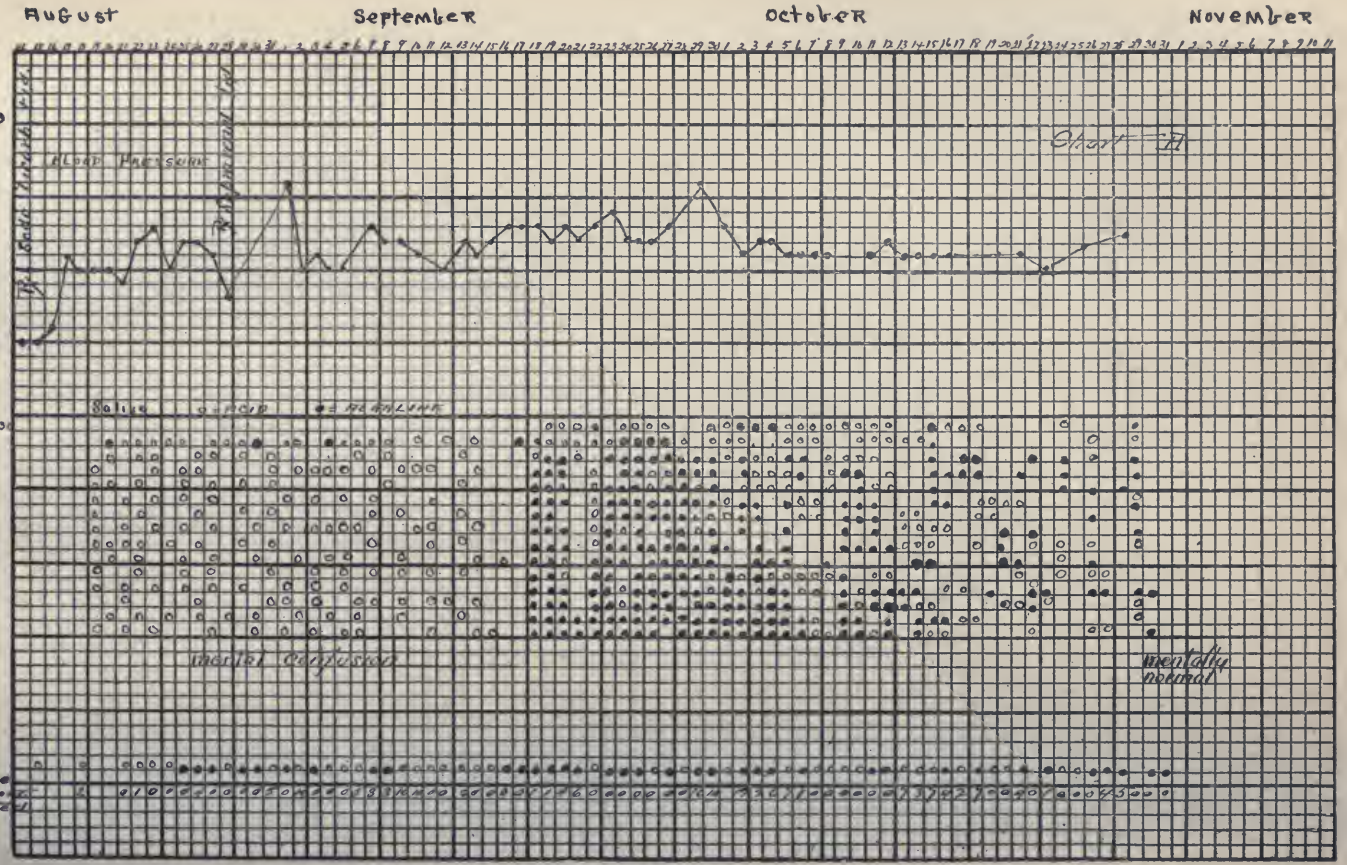

Fig. 173.—Case B.

are showing their normal reactions. There is no question that osmosis can be greatly facilitated, and that patients are not so apt to become auto-intoxicated. The physiologic symptoms, such as blood-pressure, can be adjusted by using internal secretions in a therapeutic way, following institution of treatment tending toward the establishment of neutrality.

These two procedures we consider as fundamental in the treatment of acute insanity.

Conclusions.—I think the cases just described are quite typical of two groups that can be found in any acute ward. There are other groupings of physiologic, chemical, and psychologic symptoms. I am not saying that all insanity can be divided into acid and alkaline psychosis, but I do say that there is a stage in the early development of the disease when their metabolism expresses itself in this fashion. In the two cases described here the metabolism continued to so express itself.

The practising physician has from this point of view several avenues of approaching his mental cases before he decides to place his patients into specialized treating hospitals.

To summarize: The two types emphasized here are those with high blood-pressure, mental excitement, alkaline saliva, alternating acid and alkaline urine, perspiration, and feces; and those with low blood-pressure, mental confusion, and generally acid diathesis.

CONTRIBUTION BY DR. DAVID RIESMAN

INFLUENZA[1]—REMARKS UPON SYMPTOMS, PREVENTION, AND TREATMENT

THE influenza epidemic swept over Philadelphia as a plague of unheard-of virulence from about mid-September to the latter part of October. Only a fraction of the cases were reported, so that the total morbidity is unknown and figures are mere guesses. In the mortality statistics three terms appear in relation to the disease—"influenza," "pneumonia," and "bronchopneumonia." From clinical and pathologic evidence and from epidemiologic considerations we are justified in saying that all fatal cases of pneumonia, bronchopneumonia, influenza, and even of bronchitis occurring during the prevalence of the epidemic were one and the same disease. I believe, with Christian,[2] that all fatal cases of influenza were accompanied by pneumonia except those fulminating ones in which death occurred from pulmonary edema. From the clinical standpoint it was difficult to separate the severe cases of influenza from those of pneumonia. Are they really distinct? To me it appeared as if the pneumonia was not an accidental complication, but an integral part of the epidemic disease when assuming a severe form. The undoubted occurrence of non-pneumonic or apneumonic influenza naturally suggests the idea that in the pneumonic form we may have been dealing

[1] Between September 23d and October 29th 47,012 cases of influenza were reported, indicating that about 2.5 per cent. of the population was attacked. I am inclined to think that this is far below the true proportion. The number of deaths reported from pneumonia and influenza during the period between September 30th and October 31st was 12,032. The highest number of deaths from pneumonia and influenza alone in any one day was 711, on October 15th, which is more than 100 above the average weekly death-rate from all causes in Philadelphia. Nearly one-third of the deaths occurred between the ages of twenty and thirty.

[2] Jour. Amer. Med. Assoc., November 9, 1918, p. 1565.

with a process in which bacteria other than those causing the influenza were at work. It might be conjectured that the influenza germ, whether it be the Pfeiffer bacillus or something else, greatly favored the symbiotic growth of other pathogenic organisms possible—the pneumococcus, streptococcus, staphylococcus. Be that as it may—I do not know—but for me the clinical picture of influenzal pneumonia was distinct from that of other forms of pneumonia; was that of a definite entity, as much so as scarlet fever, in which an unknown virus and the streptococcus are probably responsible for the clinical picture.

The mere fact that pneumococci, streptococci, or staphylococci are found in the lung in cases of influenzal pneumonia does not prove that they are the cause of the pneumonia. We must remember that the lungs are in free communication with the air and with the germ-laden oral and nasal cavities. After every violent cough there is an involuntary aspiration which must carry many bacteria down into the deeper parts of the lungs. In typhoid fever and in other specific diseases of the intestine many bacteria are present in the bowel contents besides the specific micro-organism. They may play a rôle, but they are not the essential cause of the disease.

Much mystery surrounds the influenza bacillus. I think we may safely say that it was present in virtually 100 per cent. of the pneumonias of the epidemic. The failure of many observers to find it in the lung tissue or the sputum was probably due to imperfect technic. If consistent presence established etiologic relationship, then we should be in possession of the cause of the disease. But that fact constitutes only one of the four laws of Koch. Neither in man nor in animals has the disease been produced experimentally with a pure culture of the Pfeiffer bacillus. The serologic reactions obtained by Spooner, Scott, and Heath,[1] while interesting and important, do not permit far-reaching conclusions with regard to the causal relationship of the Pfeiffer bacillus. The question whether the Pfeiffer bacillus is the etiologic factor in influenza still remains. Opinion counts for nothing in answer to it, but definite facts we have not.

[1] Jour. Amer. Med. Assoc., January 18, 1919, p. 155.

Some[1] have searched for a filterable or ultramicroscopic virus, but in vain.

The beginning of the epidemic in Philadelphia gave no clue as to the terrible scourge it was to become. I remember that one morning in the middle of September Dr. Wilmer Krusen, Director of Health, called me up on the telephone and asked whether I had seen any cases of influenza. Having just returned from my vacation, I had seen none. The very next day I saw two, a physician and a woman in my neighborhood. Both developed pneumonia, the physician, of the bronchopneumonic type; the woman, of the lobar type. Both recovered. Very soon the increase was fast and furious, and the majority of the cases I saw—chiefly in consultation practice and among the nurses and doctors in the Philadelphia General Hospital—were of the pneumonic type.

In an overwhelming number of cases the pneumonia arose early in the disease, sometimes in the first twenty-four hours, sometimes not until the second or third day. Percussion seemed to give more help in the early stages than auscultation. Usually some impairment would be found over a small area in the postaxillary line and about the angle of the scapula. At first this was most frequent on the left side, but later the inequality between the sides disappeared. Primary apical cases were exceedingly rare, but the apex was quite often found involved secondarily. On auscultation over the suspected area one usually could hear a shower of fine crackling râles; sometimes only at the end of a vigorous inspiration. One could predict with fair assurance that within twenty-four hours the suspected area would be dull and the seat of bronchial breathing. Sometimes the consolidation would spread with great rapidity, usually involving the whole lower lobe of the lung posteriorly and rapidly creeping forward toward the sternum. Exquisite dry bronchial breathing and bronchophony could be heard over such an area. In many instances the percussion note was as flat and resistant as over a large effusion. Nevertheless, exploratory puncture

[1] Nuzum, Pilot, Stangl, and Bonar, Jour. Amer. Med. Assoc., November 9, 1918, p. 1562.

rarely revealed more than a small amount of clear or slightly blood-tinged fluid. In the majority of severe cases a little patch of consolidation could be found in the opposite lung, generally near the vertebral border of the lower scapula or in the post-axillary region. At times the pneumonia was almost as extensive in the secondarily involved lung as in the other. Some degree of pulmonary edema, shown by diffuse moist râles, was often evident and almost never lacking in the bad cases. In cases proceeding to resolution, the pulmonary signs passed through the stages with which we are familiar in the course of ordinary lobar pneumonia.

Empyema was surprisingly rare compared with the earlier pneumonias of the army camps in this country. I was also impressed by the infrequency of pleuritic symptoms in general, so common in pneumococcic pneumonia. In a few cases, however, there was intense pain along the margin of the ribs and over the lower chest which could be interpreted only as due to diaphragmatic pleurisy.

Before leaving this phase of the subject I want to reiterate what I said with regard to the value of *percussion* in the early detection of pneumonia. I take it that the slight dulness before much else is demonstrable is due to congestion, to overfilling with blood of the part of the lung that is going to be inflamed.

The bronchopneumonic cases were in some respects a revelation to many of my colleagues and to myself. It was unusual in our former experience to find bronchopneumonia at the age period the epidemic selected—young, healthy adults from twenty to thirty-five. Hitherto pneumonia in these had been usually of the lobar type, barring the measles pneumonia among the soldiers in the army camps. Now we were confronted with a distinctly new picture. The patient had severe cough, thin, fluid, salmon-colored expectoration, high fever, dyspnea, cyanosis, râles over the chest, although often more marked over one lower lobe, with shadowy impairment on percussion, or distinct patches of dulness usually just inside the lower scapula. There was little difference in the general behavior of the two types of cases, although I carried away the not very sharp impression that

the bronchopneumonic cases did better than those of the lobar type.

Epidemic influenza usually *begins* rather suddenly, with general malaise, pains in the legs, head and eyeballs, and in the back, the last at times as severe as in smallpox. Distinct chills are not very common. Chilliness, however, was frequently complained of. Sneezing and other catarrhal symptoms were conspicuously rare. *Cough* was at times present from the first moment; sometimes its appearance was delayed for two or three days. It was variable in intensity; in some cases, however, it attained a violence scarcely matched by whooping-cough. The *sputum* varied very much, sometimes it was a glairy mucus, as in ordinary bronchitis, frequently it was a thin, reddish or salmon colored fluid; at times distinctly rusty and even tenacious, as in ordinary pneumococcic pneumonia. In a few instances it was of the prune-juice character. No conclusion of special value could be drawn from the color of the sputum, but in practically all cases in which blood was present one could demonstrate the existence of bronchopneumonia or lobar pneumonia. The *temperature* was usually high (103° to 104° F.) and hyperpyrexia was common. While true crisis occurred in some cases, the majority of those ending favorably terminated by rapid lysis. An interesting feature was the comparative slowness of the *pulse* in the first few days of the disease. It was not uncommon to find a temperature of 104° to 104.5° F., with a pulse of 80 to 90. In many cases with extensive lung involvement the respirations were also disproportionately slow. In the later stages the pulse usually became rapid and dicrotic and the respirations mounted to 50 or 60.

The *blood-pressure* showed one peculiar feature in a fair proportion of cases: a very low diastolic pressure, such as is seen in aortic insufficiency. In the majority of cases Gibson's rule was verified. Aside from toxic myocarditis, cardiac complications were rare; endocarditis was exceedingly uncommon; pericarditis occurred in several instances.

Of *gastro-intestinal symptoms* the most striking were nausea and vomiting, which in some cases attained such a degree that

everything else was overshadowed. The vomitus was often of a coffee-ground character. Bile was rarely present. The gastric symptoms were evidently toxemia, probably caused by an effort at elimination through the gastric mucous membrane, and usually yielded to treatment within twenty-four to forty-eight hours. Abdominal *tympany*, as in ordinary pneumonia, proved a distressing symptom. When marked, the outlook was usually bad. The bowels themselves gave little trouble and were either moved spontaneously or easily by enemas or mild laxatives. Diarrhea was occasionally noted; it was either (like the vomiting) a sign of toxic irritation or could be attributed to the free use of enteroclysis. Jaundice was exceedingly rare, quite unlike our experience in old-fashioned pneumonia. In a few cases the liver was distinctly enlarged, but there were no signs of cholecystitis. Pain and tenderness in the right iliac fossa suggesting appendicitis were noted in several instances, but in my personal experience none of these cases was appendicitis; virtually all were examples of pain referred from the chest. I have heard, however, of true appendicitis complicating influenza.

In only one case was I able to feel the spleen easily. At times I inferred from percussion that it was enlarged, but it is well known how unreliable percussion is in determining the size of the spleen.

Nervous Symptoms.—Nothing illustrates more strikingly the profound toxemia of the disease than the nervous symptoms in severe cases. Insomnia was very common and intractable. Muttering or active delirium was also frequently present. One of my patients, while he had a temperature of between 105° and 106° F., overpowered two nurses and jumped out of bed. It was common to see a typical typhoid state: cracked lips, dry, glazed, brown, shrunken, tremulous tongue, carphalogy, muttering delirium, incontinence of feces and urine, coma vigil. Subjective complaints were often strikingly in abeyance, and some of the worst cases with extensive lung involvement, deep cyanosis, and persistent cough never complained at all. Such patients would often answer the query "How do you feel?" with "Fine! splendid!" In time I began to dread such answers as of bad

omen. In a few cases the picture of meningism was noted, but lumbar puncture showed nothing more than an increased amount of water-clear fluid. In this type, however, the mortality was very high. Headache, while severe in a few cases, rarely lasted long, and frequently was entirely absent. In one case, that of an intern in the Philadelphia General Hospital, a peculiar state of disorientation remained for some time after convalescence was established, but cleared up eventually. Dread and apprehension seemed to me in a few instances to have a share in the fatal termination. Thus several nurses, who had seen companions die, immediately on falling ill gave up all hope of recovery, and it was well nigh impossible to imbue them with a fighting spirit. It is true not all of these died.

Urinary Symptoms.—A striking feature of the majority of cases, both good and bad, was free diuresis, probably connected with the abundant water intake and fairly efficient kidney function. Albuminuria was commonly present; no more, however, than is seen in other acute infections; but in a few cases a true hemorrhagic nephritis, with marked albuminuria, dark and light granular and cellular casts, and abundance of free blood was noted. Even in some of these the quantity of urine kept up very well. A not infrequent symptom, sometimes overlooked, was retention of urine with great distention of the bladder.

The Skin.—Herpes was rare, though when steadily looked for a single vesicle or crust, or perhaps two, could be discovered in a considerable number of cases. I did not see any other rashes except in one or two instances a rather bright general erythema. An occasional bed-sore was observed.

Subcutaneous Emphysema.—One night I was called in consultation to see a young girl of twenty who had been ill for three or four days. I found an extraordinary picture. Her neck was so swollen as to be practically obliterated, the swelling extending into the supraclavicular spaces and out toward the shoulders and upward toward the face. The girl's voice was scarcely audible. She was moderately cyanosed, had a severe cough, and an extensive bronchopneumonia. On palpating the neck structures a most exquisite crackling was detected. It is

not easy to explain the origin of the subcutaneous emphysema in this case—several have been reported in the accumulated literature—but it would seem probable that rupture of the lung occurred during cough at a point of adhesion to the mediastinal structures, as there was concomitant pneumothorax.

Cyanosis.—No symptom was so striking both to the physician and the layman and so distressing in its ominous significance as cyanosis. In mild degrees it was confined to the lips, the tips of the ears, and the finger-nails. In severe cases it was general over the face, the trunk, and the extremities. The lips and mucous membrane of the mouth often had a maroon color, while the face and neck were of a livid bluish-black hue. Coughing and other muscular effort deepened the cyanosis. As in the cyanotic cases the heart was often beating vigorously and the pulse-pressure was well maintained, the cyanosis could not be attributed to circulatory failure, nor did it seem to bear an unmistakable ratio to the amount of lung involvement. It was distinctly proportional, however, to the toxemia. For that reason and also because of its color it suggested an altered state of the blood analogous to that of acetanilid-poisoning. This led me to use the term *hemocyanosis* in speaking of it. No definite studies on the nature of this hemocyanosis exist, although Synnott and Clarke,[1] on the basis of some spectroscopic tests, concluded that there was no methemoglobinemia.

Nosebleed was very common and often profuse to the point of alarm. In previous epidemics of influenza this symptom was not prominent. Uterine bleeding, usually a premature menstrual period, was very frequent, but did not assume any serious proportions. Hemorrhages also occurred from the stomach in cases with severe gastritis. Blood in the urine was often detected microscopically, but visible blood was rare, occurring in only one or two of my cases. It is scarcely necessary to refer again to blood in the sputum. It was very common. At times there was a distinct hemorrhage, as if from a pulmonary infarct.

The *blood counts* in my cases corroborated the findings of others as to the existence of leukopenia in the early stages. In

[1] Jour. Amer. Med. Assoc., November 30, 1918, p. 1816.

the later stages the counts often rose to 12,000 or 13,000, sometimes higher, in the presence of a complication such as otitis media.

Phlebitis, a not infrequent complication of ordinary lobar pneumonia, was rare in the contagious pneumonia of the epidemic. I can recall but one case.

Pregnancy.—When the disease occurred in a pregnant woman in Philadelphia it nearly always spelled death. Of those attacked at the height of the epidemic only a vanishing number recovered. It seemed to require but a short exposure for the pregnant woman to get the disease. I remember a particularly tragic case I saw with Dr. I. V. Levi. A young man came down with a severe influenzal pneumonia; his wife, who was in the seventh month of her pregnancy, was immediately urged to leave the house. This she declined to do. We therefore strictly forbade her going into the sick room, She did so, however; promptly came down with pneumonia, and died in four or five days, while her husband was slowly recovering after a desperate attack of bilateral pneumonia with extremely severe gastric symptoms and perfectly horrible coughing fits. One pregnant woman, whose husband had a virulent influenzal pneumonia to which he succumbed, was isolated as soon as practicable and escaped, one of the few exposed ones to do so.

Most of the pregnant women aborted. At first I hoped that this might be an advantage, but it did not prove so. The majority died with symptoms of profound toxemia, cyanosis, typhoid state, and extreme tympany. In a number of cases the question arose as to the advisability of inducing labor. My advice was against it, and this was likewise the opinion of obstetricians called in consultation in some of the cases seen by me. As I have already stated, a large number of women had a premature menstrual period at the height of the disease. It did not seem to me that this had any influence in one way or another on the course of the infection.

Atypical Cases.—1. *Fulminant pulmonary edema* with death in twenty-four hours or less. These cases were fortunately rare, and seemed to occur in such persons as were exposed to con-

centrated infection and at the same time exhausted by overwork. These patients drowned in their own juices before pneumonia had time to develop. The poison behaved very much like some of the poison gases used in the war.

2. *Prostration Cases.*—In several adult patients I observed a condition that may be described as follows: A slight subfebrile state, with temperature a degree or more above the patient's normal—which in many was 97.4° to 97.8° F.—malaise becoming more marked in the late afternoon, and a physical prostration, and at times also a mental lassitude, quite out of proportion to the demonstrable signs. In some cases a cough existed and gave a ready clue to the infection. I believe these cases illustrate the occurrence of influenza in persons having a moderate degree of immunity.

3. *Hemorrhagic Nephritis.*—As a part of a severe influenzal infection this has already been described. It occurred, however, as a seemingly primary febrile disease, especially in children. While difficult of proof, the view that, in the absence of scarlet fever or other clearly demonstrable cause, it was an influenzal effect seemed justified.

One feature of epidemiologic interest should be mentioned, namely, the rarity of other acute infections during the reign of the influenza. It is possible that this rarity was only apparent and produced by the fact that my services were almost completely monopolized by influenza cases. Nevertheless, I am practically convinced of the absence of tonsillitis, ordinary acute colds, and erysipelas during the epidemic.

Treatment.—Our experience in Philadelphia taught us a painful lesson. We were unprepared for the great emergency as regards doctors, nurses, hospital space, drugs and supplies, coffins, etc. One of the most distressing features was that many patients suffered and died without medical aid. The doctors worked as they had never worked before, but they were unable to answer more than a fraction of the calls. The lessons learned I fear will be forgotten, but they ought not to be. I want to point out some of them, for to be guilty of unpreparedness in the future would be a municipal crime.

1. *The Zone System for Doctors.*—During the epidemic it often happened that at the time when many sick were unable to get a doctor, two or three or four might be visiting patients in the same block. I remember one day at the height of the epidemic in one short suburban square there were four doctors' motor cars. One physician could easily have seen all of the cases in the square, while the other three, I calculated, could have seen forty-five patients in the city during the time consumed in making the trip. My plan is to zone the city and to assign to practitioners a definite district to be under their charge during a virulent epidemic. Judgment must, of course, be used; to the younger man a larger number of houses can be assigned than to the older one. Objection might be made that patients want their own doctors, but I found during the epidemic the people were glad to get anyone who could come soon enough and often enough. Nor does the plan prevent the physician from seeing his own patients, provided he has discharged his assigned duty. It may be that doctors will object to such a plan as I propose. If they do, they cannot be coerced, and the execution of it would have to be left to volunteers. The city, of course, could hire men, but if that is to be done then plans as to their number and distribution should be made so as to be ready when required by an emergency.

2. There should at all times be a census or *roster of nurses* in the hands of the Health Department. No single patient should have two nurses unless the need is certified to by the attending physician. The department should likewise have a record of all semitrained and volunteer nurses, and both they and the regular nurses should be provided with printed postal cards on which to notify the Health Department whenever they leave a case.

3. *The Mobilization of Social Workers.*—A complete registry of social workers should be kept in the offices of the Health Department, and the best possible use made of these valuable adjuncts to medical and charitable relief. In one of the sections of the city especially hard hit by the epidemic the people raised a fund and among other things hired two capable social

workers who ferreted out the very bad and neglected cases. For them they procured nursing and medical attention, and even arranged consultations between men of the neighborhood and consulting physicians.

4. The *druggists* were fearfully overworked and further handicapped by a shortage of much-used drugs. It was suggested by someone that physicians should agree upon stock prescriptions to be put up in bulk, and called for by patients before the visit of the doctor. The plan is of doubtful utility.

5. *Reporting of Cases.*—This is eminently desirable. It was neglected by doctors overwhelmed with work. Moreover, they saw no special rationale in the time-consuming procedure, as nothing was done.

6. *Emergency Hospitals.*—Plans must be made for the creation of emergency hospitals on short notice, and must, like all other plans, be ready in a pigeonhole, like the campaign plans of an army general staff. Only in that way can one administration benefit from the experience of another.

7. *Quarantine* is of doubtful utility in an epidemic of such terrible proportions. If it were to be done it would probably lessen the reporting of cases.

8. The *closing of public places* seems to me a wise measure if judiciously enforced, but the matter is a difficult one, as is well brought out in the Report of the Special Committee of the American Public Health Association on Influenza.[1] In Pennsylvania the State Health Department closed schools, churches, moving-picture houses, theaters, and saloons. I hold no brief for saloons, but cannot help questioning the consistency of the state in closing them when factories, department stores, lunch counters, barber shops, etc., were kept open.

9. *The Wearing of Masks.*—This has proved itself a measure of unquestioned utility. It is, of course, necessary that the mask be properly made, rightly worn, and disinfected after use.

10. The *washing of the hands* is probably one of the most important measures in the prevention of the spread of the disease.

11. *Gargles and Mouth-washes.*—The use of mouth-washes and

[1] Jour. Amer. Med. Assoc., December 21, 1918, p. 2068.

gargles does not appear to me a sensible method of prophylaxis. I am aware that quinin in dilute solution, as shown by Kolmer, is pneumococcidal, but mouth-washes and gargles can never sterilize the whole oral and pharyngeal cavity and may deprive the mouth of its protective covering of mucus and saliva.

12. *Vaccination.*—As a direct protection against influenza the value of vaccination with a mixture of organisms seems in the opinion of most critical writers to be not yet established. My own experience is rather encouraging. Moreover, I have seen no harm come from it. The procedure may, in addition, have a psychologic value, in that it banishes in the timid the panicky dread of the disease that cannot but help to lower the resistance.

The work of Austin and Cecil and others seems to attest the value of vaccination against pneumonia. Whether it holds good against the influenzal pneumonia as well as against that due to Types 1, 2, and 3 of the pneumococcus is as yet unproved.

Direct Treatment of the Disease.—1. *Simple Influenza.*—The patient must go to bed immediately, must be isolated, and the attendants and family masked. The diet may be liberal—milk, milk-toast, cocoa, chicken or lamb broth, cereals, stewed fruit, junket, wine jelly, soft-boiled or poached eggs, orange-juice, pineapple-juice. Water should be given in abundance, a glassful every three hours; it may be given as lemonade, with grape-juice or with orange-juice. The bed-pan should be used whenever possible. Exposure increases the chances of pneumonia. The bowels should be moved in the beginning with citrate of magnesia. In the medicinal treatment I have used various combinations. without feeling that any is in the least a specific. A fairly satisfactory one is the following:

℞. Quinin. salicylatis..... 2
Acetphenetidin..... 2
Pulvis ipecac. et opii (Dover's powder)..... 0.15.—M.
Divide into 12 capsules.
Sig.—One every three hours.

Or,

℞. Acid. acetyl-salicylic..... 2;
Acetphenetidin..... 1.5;
Pulvis digitalis..... 0.1—M.
Divide into 12 capsules.
Sig.—One every three hours.

Or,

℞. Acid. acetyl-salicylic..... 2;
Acetphenetidin..... 1.5;
Urotropin..... 2.—M.
Divide into 12 capsules.
Sig.—One every three hours.

The digitalis combination I have used in cases in which the pulse seemed to be soft from the very beginning. Dr. Edwin Zugsmith, of Pittsburgh, tells me that he has had very good results with a combination of sodium salicylate and urotropin.

2. *Severe cases*, by which I mean those with pulmonary involvement. The general principles are the same as those already given, but for this group of cases a nurse is almost indispensable. The doctor should invariably write out all directions in full, especially as in the stress of an epidemic he is not able to see his patients very often.

The so-called alkaline treatment was used by most physicians with whom I came in contact in the treatment of severe cases. I was in the habit of prescribing the following mixture:

℞. Spiritus ammonii aromatic..... 5–10
Liquor. ammonii acetatis..... 30
Liquor. potassii citratis.....q. s. ad 150.—M.
Sig.—A tablespoonful in a glass of water every three hours.

In severely toxic cases the alkalies by mouth were supplemented by enteroclysis, with solution of sodium bicarbonate, a tablespoonful to a pint of water. In all severe cases digitalis was prescribed from the beginning, either the tincture of digitalis or digalen, occasionally digipuratum. In the later stages the dose of the tincture or of digalen would be 1 c.c. (15 minims); in the case of digalen to be given hypodermically every four hours.

In some cases we used strophanthin intravenously, 0.5 mg., and in every instance there was an immediate and perceptible influence upon the pulse which unfortunately was not sustained, and only postponed but did not avert the fatal ending.

In circulatory failure, shown by rapid, feeble pulse and pulmonary edema, atropin sulphate, $\frac{1}{75}$ gr.; caffein sodium

benzoate, 0.12; camphorated oil in ampules, and, at times, adrenalin were used in addition to digitalis.

Throughout the epidemic glucose was extensively employed upon rather ill-defined indications, perhaps as much for general toxemia as for anything else. It was given by enteroclysis in 5 per cent. solution, and also intravenously. I cannot say that it has an outstanding value, but by supplying an easily metabolized material as well as a considerable amount of fluid it has possibilities of doing good.

With regard to alcohol, the last word has not yet been said. In the beginning of the epidemic little use was made of it. Later, somehow, we all fell into giving it quite freely, but I cannot say that I saw it do much good. Oxygen, though administered in enormous quantities, even to the point of wastefulness, seemed to have little influence upon the cyanosis, but did seem to lessen the dyspnea in some cases. Arsphenamine has been used empirically abroad. I have had no personal experience with it.

Relief of Special Symptoms.—*Vomiting.*—This frequently proved a tax on therapeutic resources. We found that it was best to give no food at all for six or eight hours and to apply a mustard plaster to the epigastrium, and then to begin with teaspoonful doses of buttermilk every fifteen minutes, increasing the amount and lengthening the interval as the stomach proved more retentive.

Diarrhea.—This very rarely required active treatment. When it did, two or three doses of bismuth subnitrate (0.5 to 0.6) proved effective.

Abdominal Tympany.—This symptom is met with under a variety of conditions, and is so distressing that it is well to have a routine treatment for it. If the patient has been taking milk, it has been my practice to cut off the milk and substitute broth or albumin-water for twenty-four or thirty-six hours. An asafetida suppository (0.6) and turpentine stupes to the abdomen prove helpful in the milder cases. If they fail, an asafetida enema (60 c.c. of milk of asafetida in a small amount of starch-water or plain water) may be used. If these measures fail,

pituitrin should be given hypodermically in doses of 0.5 to 1 c.c. It has taken the place of eserin, which was formerly used to stimulate intestinal peristalsis.

Cough.—Mustard plasters or dry cupping sometimes gave a measure of relief, but in the majority of bad cases an opiate was necessary.

Insomnia.—When the bromids—sodium bromid in doses of 0.6 to 1—failed to answer, my first resort was to chloralamid in 1-gram doses or to veronal in doses of 0.3. Failing in these, and they often failed, morphin had to be used.

Pyrexia.—Nothing special was done to combat the fever unless it was high. If it was persistently over 104° F., we resorted to sponging.

Cyanosis.—I have indicated in the foregoing that the cyanosis is chiefly a toxic symptom and that oxygen had little influence upon it. The general measures, such as the use of alkalies, perhaps of glucose, and the free administration of water, undoubtedly combated the toxemia and incidentally the cyanosis, at least in a measure. Several times I resorted to bleeding and the substitution for the blood of alkaline solutions, intravenously. But as all of these measures sometimes failed, I thought that transfusion, with or without preliminary bleeding, was worthy of a trial; but in the few cases in which this procedure was suggested it could not be carried out; in some, because the patient became moribund and the case hopeless before all the arrangements could be made; in one, seen with Dr. Reif, because the blood of every donor tried was immediately coagulated by the serum of the patient.

Pleural Effusion.—In the foregoing I have already stated that large effusions were rare, but even in a few cases with limited collections, the withdrawal of some of the fluid seemed to exert a most favorable influence upon the subsequent course of the disease. Thus, in the case of a doctor's wife, who had double pneumonia and seemingly had had a crisis, the temperature after a few days shot up again and persisted with rising pulse-rate and rapidly increasing prostration. Although the physical signs were those typical of consolidation—bronchial breathing

and bronchophony—an exploratory puncture revealed the presence of turbid fluid. A few syringefuls of this were immediately withdrawn, and thereupon, without any further interference, the patient began to improve and was soon on the high road to recovery.

Convalescence.—The physician must have definite rules for dealing with convalescent patients. Even after a mild influenza the patient should not be allowed to leave the bed until the temperature has been normal, or preferably slightly subnormal, for two full days. After that he should abstain from work until at least a week has elapsed. Severe cases require a prolonged convalescence. The patient must be kept in bed for ten days after the temperature has reached normal and abstain from undue activity for two weeks longer. It is best to send such patients away at the end of the ten-day period. For Philadelphians, Atlantic City offers all the desiderata for speedy recuperation.

During convalescence the heart sounds should be watched as to their force and rate. Absence of substance or strength and rapidity indicate a not completely vanished toxic myocarditis, which, in older persons at least, requires time for complete restitution to normal. Such persons must be kept in bed or in their rooms until the abnormal signs have entirely disappeared. Abundant food and tonic medication, for which I prefer elixir of iron, quinin, and strychnin, are indicated. If the appetite lags, it may be stimulated by an alkaline stomachic, as, for example, the following:

℞. Sodii bicarbonatis..... 6
Tinct. nucis vom..... 6
Tinct. cinchonæ comp..... 60
Aq. cinnamomi.....q. s. ad 90.—M.
Sig.—Teaspoonful in water three times a day.

I believe that the medical profession, mindful of the experience in the epidemic of 1890, is taking better care of convalescing patients than was the case then, and that we shall for that reason hear less of delayed fatalities.

As I write this article there is evidence that the epidemic is coming back on its second swing through the country. The

earlier cases are again mild, but during the last few days the dreaded pneumonic type, with profound toxemia, is again manifesting itself. The age incidence in this second visitation is somewhat different from that in the first. Children are more frequently attacked; also people of middle age and beyond. The children show a protracted fever of 103° to 104° F., with slight cyanosis of lips, delirium, cough, and a variable pulmonary involvement; a few râles in one lobe or in both lungs, or extensive consolidation. The persistence of the fever is one of the striking features. Fortunately, a fatal outcome in children is rare. In adults, however, the toxemia quickly gains the upper hand over the merely local symptoms, and puts life in peril in many cases.

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